# Compressed Air Magazine

AUGUST 1946

A LANDMARK IN
NAVAJO COUNTRY

Shiprock, in Northwestern
New Mexico, is familiar to
travelers of Highway 66

(New Mexico State Tourist
Bureau Photo)

VOLUME 51 • NUMBER 8 NEW YORK • LONDON

# PLENTY OF E. P.

## To Protect Your Drills

E. P. in a lubricant means ability to withstand "Extreme Pressure." Texaco Rock Drill Lubricants (E.P.) have the high film-strength necessary to resist the extreme pressures encountered in hard-rock and deep-hole drilling. They protect moving parts from wear under the severest loads . . . assuring greater footage, longer drill life and lower maintenance costs.

Other advantages of Texaco Rock Drill Lubricants (E.P.) are their exceptional effectiveness in preventing rust, their ability to resist washout and stand up under all temperatures, and their freedom from objectionable odor.

Texaco Rock Drill Lubricants (E.P.) meet the requirements of every type of drill and operating condition, and conform to the lubrication specifications set by leading rock drill manufacturers.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write:

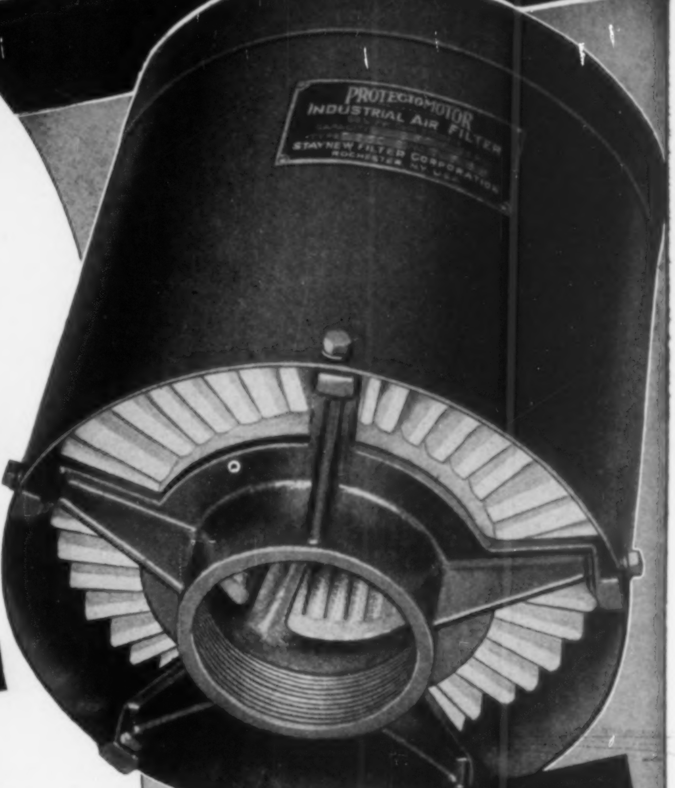
The Texas Company, 135 East 42nd Street,
New York 17, N. Y.

TEXACO REG. T. M.

**TEXACO Rock Drill Lubricants (E. P.)**

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON EVERY SUNDAY NIGHT—CBS

# WHY PROTECTOMOTOR INTAKE FILTERS ARE BEST FOR AIR COMPRESSOR USE ★ ★



## ★ HIGH EFFICIENCY WHEN INSTALLED

Protectomotor Air Filters for internal combustion engines and compressors feature dry-type filtering media. These media are selected to fit particular installation conditions. They have been scientifically tested in the laboratory and proven by field use. Used in combination with the patented Radial Fin Insert Construction, they provide highest operating efficiency.

## ★ INCREASED EFFICIENCY WITH USE

Protectomotor filtering efficiency actually *increases* when dust begins to accumulate on the surface of the media, since this forms a pre-coating or filter-aid of the very material which is being handled.

## ★ LOW RESTRICTION TO AIR FLOW

Protectomotors at maximum ratings offer initial resistance to air flow of less than ½" of water. Since the exclusive Radial Fin Construction provides a maximum of filtering area, this resistance is held to a minimum throughout the life of the filter.

## ★ SERVICING SELDOM NECESSARY

The Protectomotor is a masterpiece of simple, rugged construction. There are no moving parts, no reservoirs, no liquids. The extremely large active filtering area reduces cleaning to an absolute minimum for any given set of conditions. When required, cleaning is quickly and easily accomplished by vacuum, compressed air, or washing.

## ★ POSITIVE PROTECTION ★ ★ ★ ★

Inherent characteristics of the dry-type filtering media provide *positive* protection. Performance is *not* dependent upon periodic renewal of viscous coatings or other filter aids. Ideal for dust storm areas.

## ★ EFFICIENT AT HIGH OR LOW TEMPERATURES

As the filtering media used are of the dry-type, peak efficiency is maintained under all atmospheric conditions. There is no oil to evaporate at high temperatures or to congeal at low temperatures.

**More than Half a Million Installations on Internal Combustion Engines and Compressors since 1920**

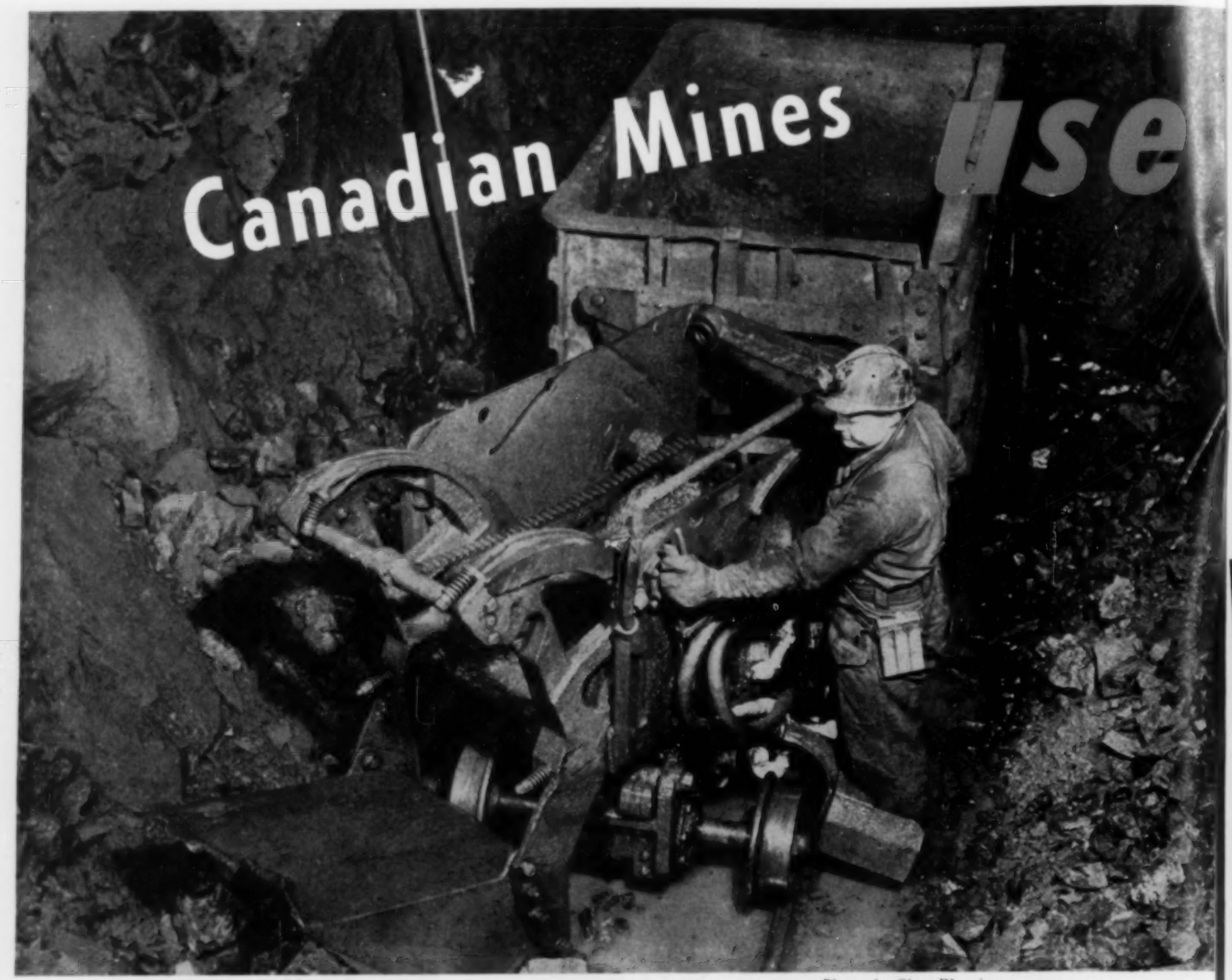
**Write for Catalog and Data Blank for Free Analysis of your Requirements**

Radial Fin Construction

**DOLLINGER**
**REG. PROTECTOMOTOR U.S. PAT. OFF.**
**STAYNEW FILTERS**

## DOLLINGER CORPORATION

**7 Centre Pk., Rochester 3, N. Y.**



*Photos by Chas. Warmington*

The RockerShovel at this property

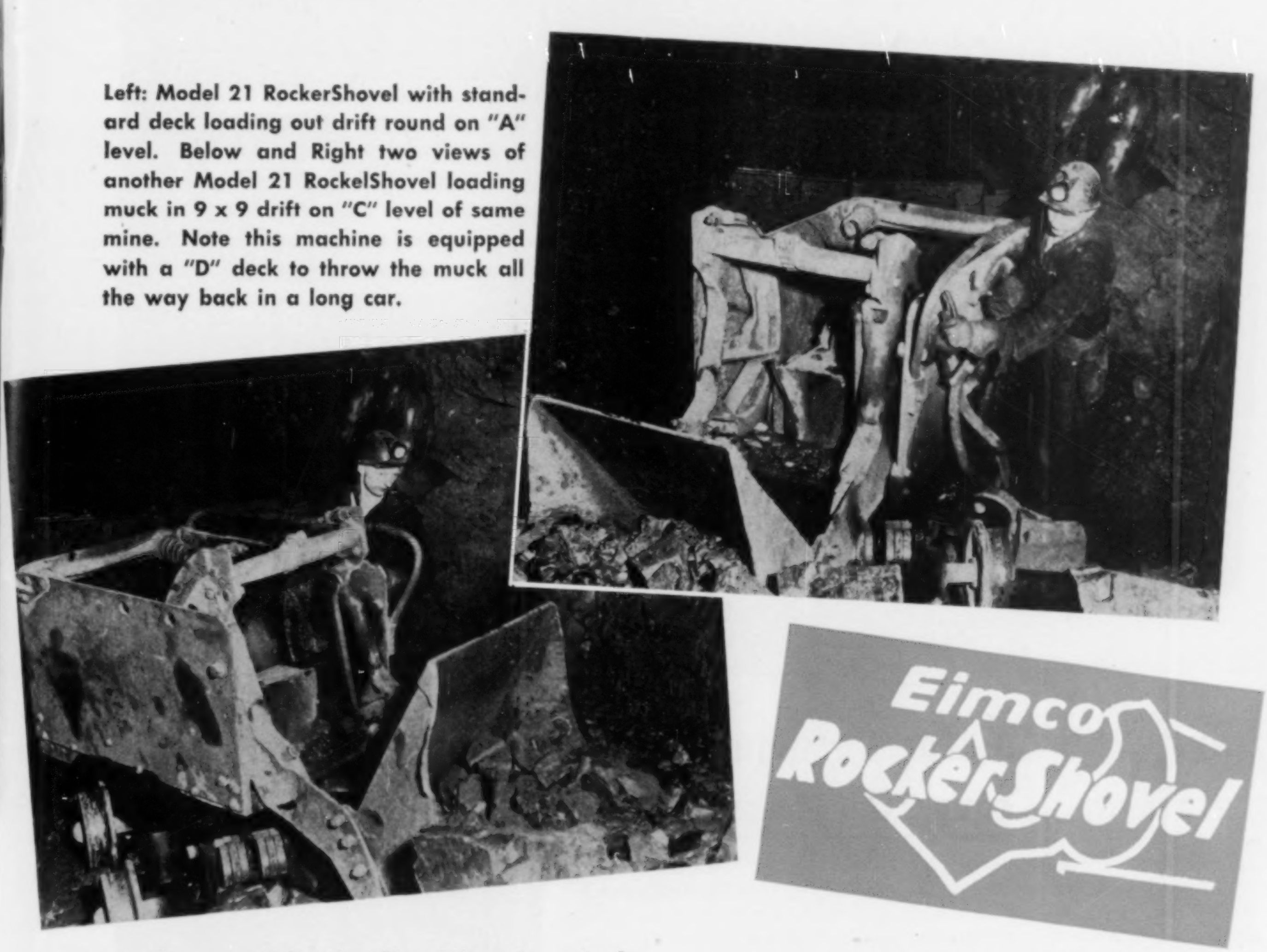
The Model 21 RockerShovel loads at the rate of two tons per minute. It is a heavy-duty machine made for continuous 24 hour operation year after year. The Model 21 is easier to operate and has many exclusive safety features for the protection of the operator. RockerShovels have won every competitive test on speed, efficiency, air consumption or maintenance costs.

Canadian Mining Companies are using RockerShovels to speed their development work in drifts and crosscuts. A number of these Canadian Companies are using their RockerShovels to load out of shrinkage stopes. Cost records kept by these companies show that using RockerShovels is much cheaper, per ton of ore loaded, than the installation, operation and maintenance of chutes, gates, etc.

One large Canadian Mining Company (see pictures) is using Eimco RockerShovels for loading from its development headings. These headings are 9′ x 9′ and many miles of this work have been completed in the last few years. The drifts are used as haulageways for transporting the ore.

# RockerShovels

Left: Model 21 RockerShovel with standard deck loading out drift round on "A" level. Below and Right two views of another Model 21 RockelShovel loading muck in 9 x 9 drift on "C" level of same mine. Note this machine is equipped with a "D" deck to throw the muck all the way back in a long car.



Eimco RockerShovel

The record for Candian Mines is typical — in all parts of the world where mining is an important economic pursuit RockerShovels are the choice for mechanical loading. Dependable operation, low cost per ton of material handled, ease of maintenance, speed and efficiency are the factors which determine this preference.

When you consider your loader — remember, The Eimco Corporation stands behind its equipment. The inherent superiority of Eimco RockerShovels has been so thoroughly proved that every machine sold now carries a positive money-back guarantee that it will outlast and out-perform any other mucking machine of comparable size and type at any air pressure and under any working condition.

**EIMCO**

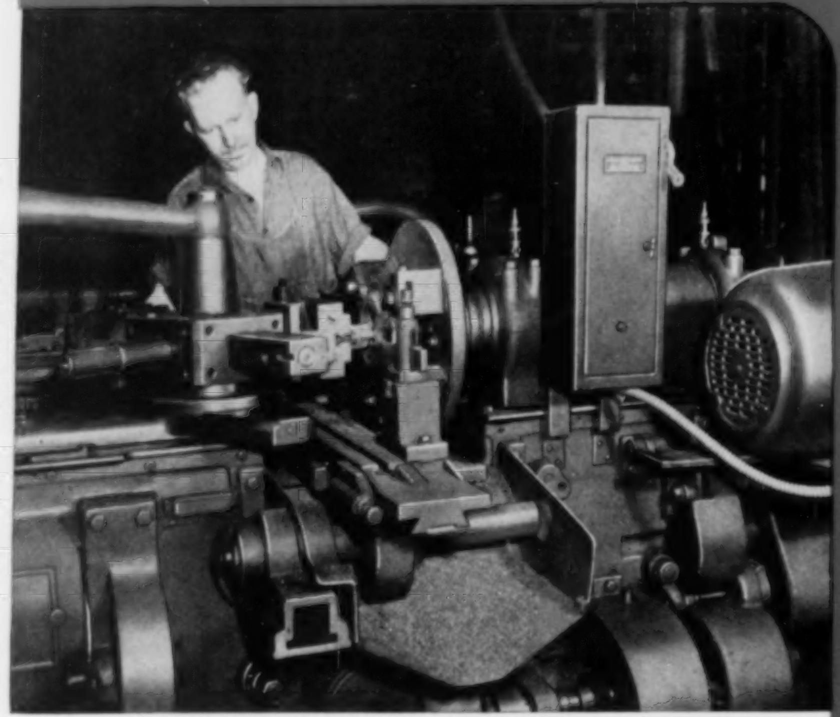
THE EIMCO CORPORATION

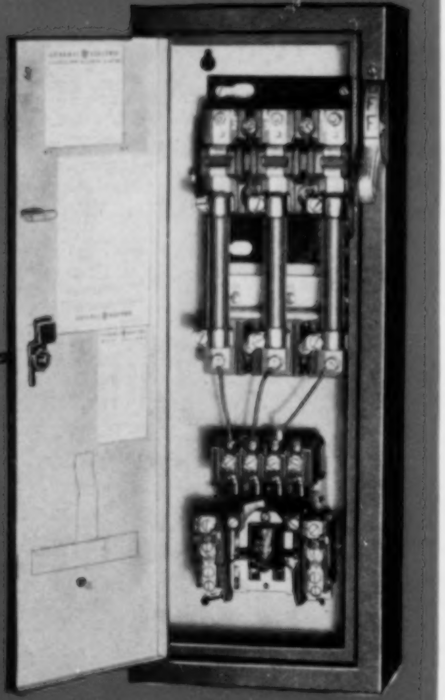
*The World's Largest Manufacturer of Underground Rock Loading Machines*

Executive Offices and Factories — Salt Lake City 8, Utah: Branches — 67 Wall St., New York 5 — 111 W. Washington St., Chicago 2 — Mills Bldg., El Paso — 1217 - 7th St., Sacramento 14

A-120

# 300 G-E COMBINATION MOTOR STARTERS...





## ...give White Motor Company real protection...save time, money, too.

Magnetic starter and motor-circuit switch in *one* unit—G-E "combination" motor starters of this type give co-ordinated control to over 300 machines in the White Motor Company plant in Cleveland.

The starter shown above is installed on a lathe used in making water pumps. Others control drill presses, shapers, boring mills, grinders, and many other types of machines.

### Here's Why the Combination Starter Was Chosen

- Fast-acting overload relays protect the motor controlled from overheating—and fuses protect it from damaging short circuits.
- Safety for operators is assured by interlocking doors. While the power is on, the door cannot be opened.
- Quick servicing and availability of repair parts is made possible by G.E.'s broad network of sales outlets.

### Wide Field of Application

This motor company represents just one of the many different industries in which G-E combination starters are at work today. Why not give the advantages of these compact, time-saving starters to *your* plant. Our engineers will be glad to help with your application. Get in touch with our local office today. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

**GENERAL ELECTRIC**

676-200-8910

### HOW YOU SAVE...

. . . TIME. Instead of buying two devices, you order and install only one. Mounting time is cut as much as 40 per cent.

. . . SPACE. Compact combination starters can be mounted in small unused places near to or remote from the operator.

. . . MONEY. The list price is slightly more than for two separate devices, but the difference is more than made up by savings in wire, conduit, and fittings.

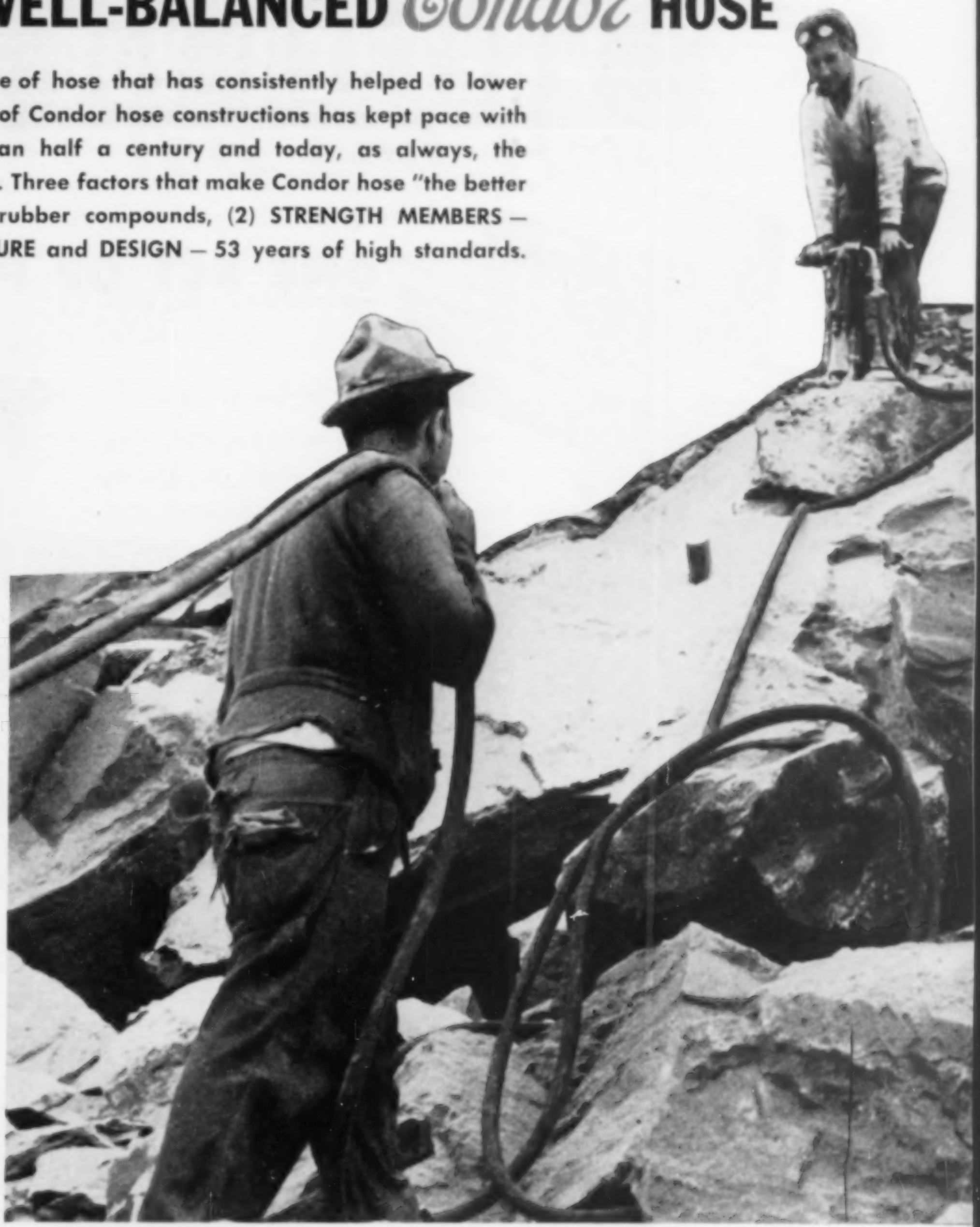
MORE INFORMATION about combination starters is given in our Bulletin GEA-3715A. Ask our local office for your copy.

# Contractors, Quarriers, Miners
# *Prefer* MODERN, WELL-BALANCED *Condor* HOSE

**Manhattan makes a completely engineered line of hose that has consistently helped to lower costs and speed up schedules. Development of Condor hose constructions has kept pace with advancing methods of operation for more than half a century and today, as always, the Condor line sets the standard for rubber hose. Three factors that make Condor hose "the better buy" are (1) FLEXLASTICS—Manhattan's own rubber compounds, (2) STRENGTH MEMBERS—special construction features, (3) MANUFACTURE and DESIGN—53 years of high standards.**

*Condor* HOMO-FLEX WATER HOSE gives exceptional service on rugged road work where hose is constantly twisted and dragged over rough ground, rocks, stakes, etc. Safe at working pressures of 150 to 350 lbs. per square inch according to diameter.

*Condor* HOMO-FLEX AIR HOSE—Freedom from kinking. Lighter, easier to pull in long lengths. Resists the gouging and abrasion of jagged rock and stands the hammering pressure of an air drill. Men like "easy-to-handle" Homo-Flex. ➡



*Condor* PILE DRIVER STEAM HOSE has driven the piles that hold some of the largest structures. Contractors prefer Condor because it is always up to standards of safety and long life.

*Condor* HOMO-FLEX SUCTION HOSE, non-metallic reinforced, for safety in mines and for general service. Returns to original shape if crushed.

*Condor* SAND SUCTION HOSE for heavy duty sand suction and dredging. Engineered to resist collapsing under suction and discharge pressures.

## 10 ADVANTAGES
### OF HOMO-FLEX HOSE

1. Extreme flexibility—easy to handle
2. Resists kinking
3. Light in weight
4. Practically inseparable cover and plies—balanced homogeneous construction
5. Withstands high pressures and surges with wide margin of safety
6. Uniform inside diameter
7. Less elongation and expansion
8. Less fatigue to operator
9. More production
10. Lower ultimate cost

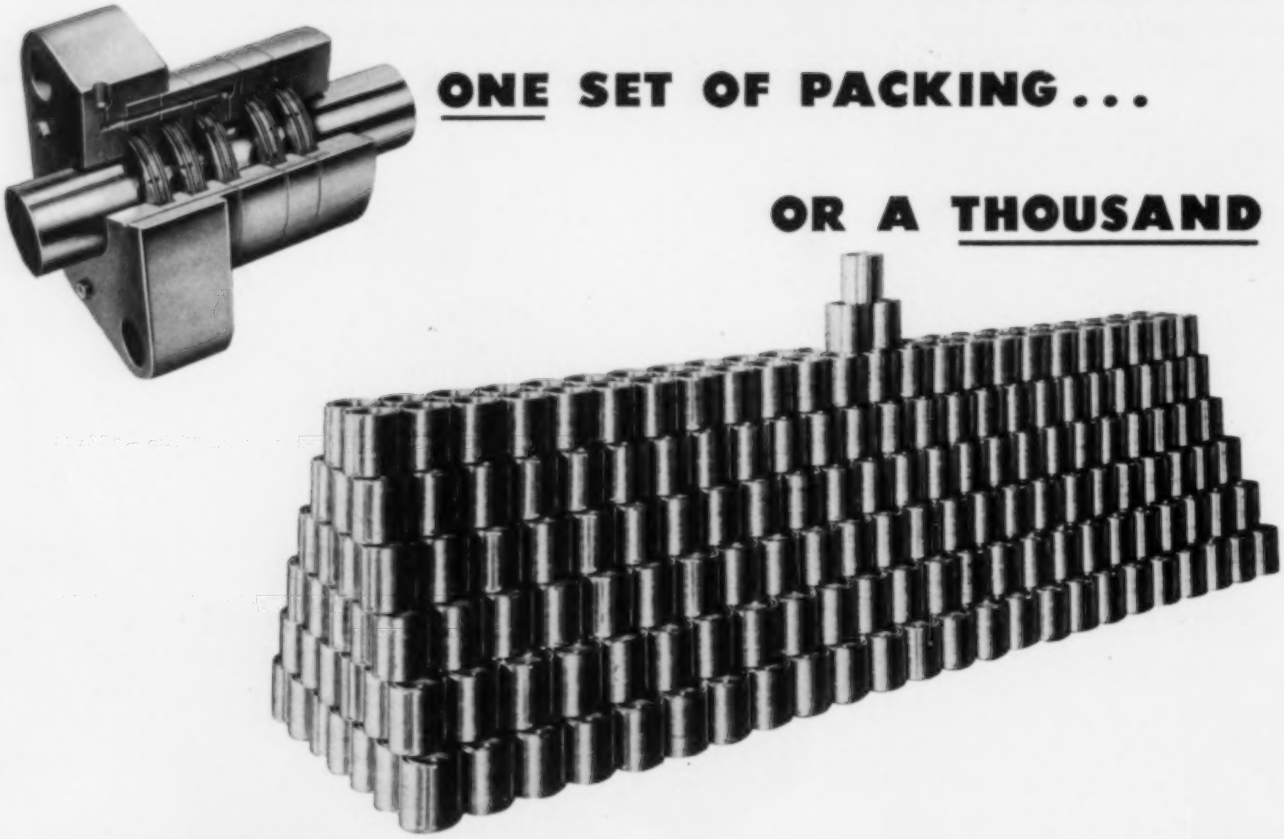
## *Condor* HOMO-FLEX HOSE

Developed by Manhattan engineers to fill a need for a lighter, more flexible, streamlined hose that would last longer than conventional type hose. New Homo-Flex construction withstands destructive pulsations of pressure. Turnate Vulcanization makes an inseparable and uniform nose wall. In services where frequent handling and high pressures break down heavier hose, men are enthusiastic for Homo-Flex, the modern streamlined hose.

*FLEXLASTICS is an exclusive Manhattan trade mark. Only Manhattan can make FLEXLASTICS.*

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION
EXECUTIVE OFFICES AND FACTORIES PASSAIC, NEW JERSEY

# WHETHER YOU REQUIRE



**ONE SET OF PACKING . . .**

**OR A THOUSAND**

# COOK IS READY TO SERVE YOU

Whether your requirements are small or large, Cook is always ready to serve you.

And here at Cook there is one standard of service, and only one—the best that a capable, efficient organization can render. So, whether you need a single set of packing or a thousand, you can count on the same prompt and painstaking attention for which Cook is noted.

We can prove this to your satisfaction if you will send us your order the next time you need packings. Remember, there is an approved style of Cook packing for every make of engine and compressor. A copy of the Cook Packing Catalog No. 440 will be sent on request. Write for it today.»

Sealing Pressures Since 1888

**C. LEE COOK MANUFACTURING CO.**
INCORPORATED
**LOUISVILLE, KY.**

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

# "Double, Double, Toil and Trouble"

An iron cauldron sufficed to handle the most devilish brews known to witchcraft back in the days of Macbeth.

## *Times and Brews Have Changed*

Iron pumps cannot be used to handle all of today's chemicals. Many of these require pumps built of new materials that resist corrosive action.

That is why we developed "IRCAMET"—the new nickel-chromium alloy now used exclusively in many I-R Chemical Pumps.

## *The Leakollector Is New*

And remember—all I-R Chemical Pumps use the patented LEAKOLLECTOR—a gland which collects and leads away all leakage from the stuffing-box—no leakage can reach pump bearings.

*Let the nearest I-R engineer help you with your pumping problems.*

**Smaller sizes for capacities up to 1300-gpm and heads up to 230 ft. and temperatures up to 275°F are available in IRCAMET, Bronze or Iron.**

**Large sizes for capacities up to 3000-gpm, heads up to 160 ft. and temperatures up to 800°F are available in IRCAMET, Stainless Steel, Bronze or Carbon Steel.**

Ingersoll-Rand
69393-4

The Cameron ***SHAFT-SEAL*** can be used on all sizes of I-R Chemical Pumps.

SEVENTY-FIFTH ANNIVERSARY

COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

**Ingersoll-Rand**

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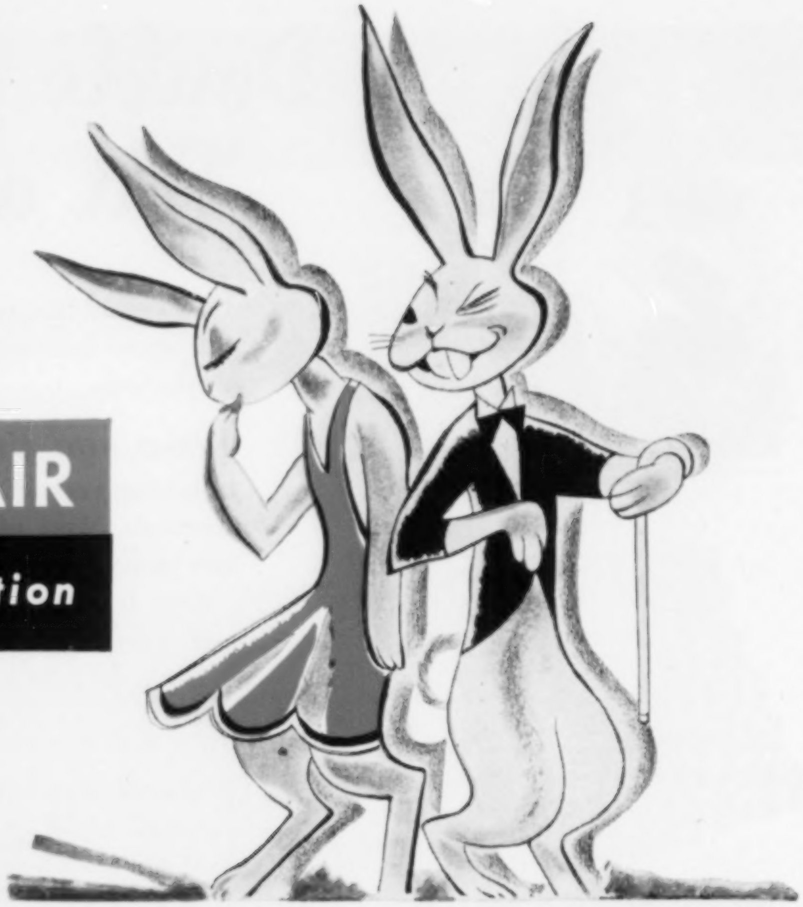
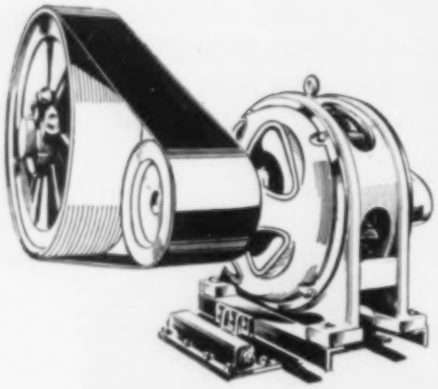


# A PERFECT PAIR

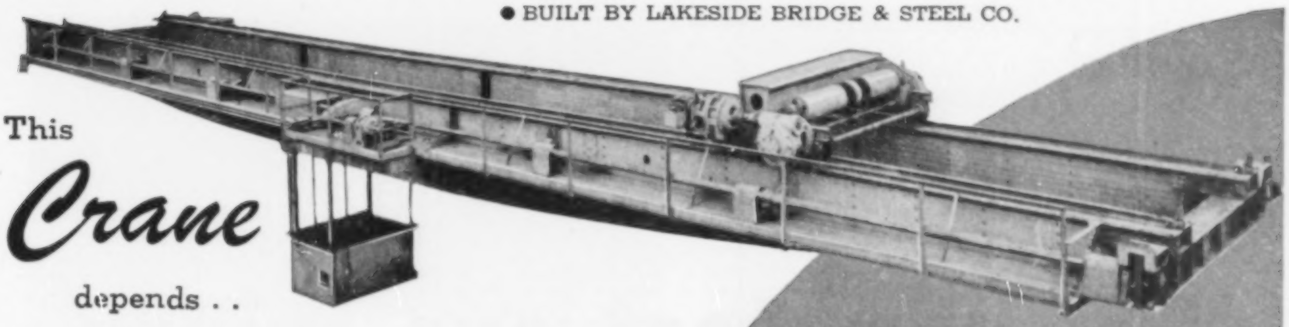
**for greater production**



## IN MODERN POWER TRANSMISSION IT'S FLAT LEATHER BELTING AND A PIVOTED MOTOR BASE

To keep compressors running smoothly with the minimum of time out for costly, unexpected, time-consuming repairs, specify this modern drive. The proved advantages of modern flat leather belting, coupled with a pivoted motor base, mean a dependable supply of compressed air month after month.

**AMERICAN LEATHER BELTING ASSOCIATION · 41 PARK ROW · NEW YORK 7, N. Y.**

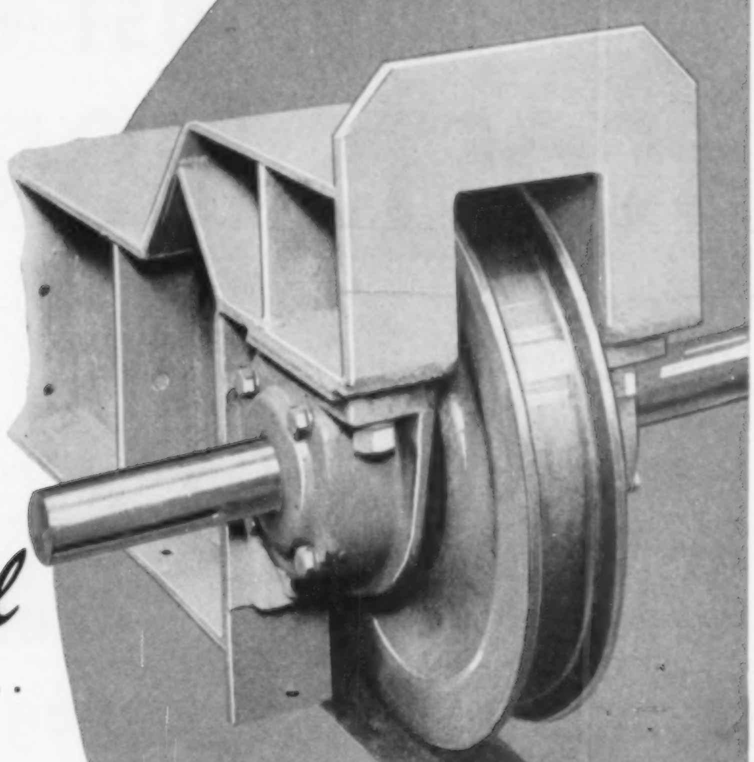


● BUILT BY LAKESIDE BRIDGE & STEEL CO.

This *Crane* depends . .

on this *Bridge Wheel* that depends . . .

on **SKF** Bearings



SKF Spherical Roller Bearings are equally spaced either side of the wheels on the Bridge End Truck of this 10-ton, 97-foot span Lakeside Dynamic Crane. They automatically take care of misalignment due to load deflections of axles and trucks . . . carry all thrust loads. Another outstanding result of SKF's pioneering the self-aligning roller bearing. 6060

SKF INDUSTRIES, INC., PHILA. 34, PA.

# the slightest eye-injury COSTS MORE

## than the goggles that can prevent it

Typical records indicate that even the slightest of eye-injuries costs (in lost time, idle machine time and medical attention) approximately $15.00. The Society for the Prevention of Blindness estimates that *ninety-eight per cent* of these injuries can be prevented by the use of safety goggles (averaging in cost $1.50 a pair). What piece of plant equipment costs so little and returns its cost so many times?

Let your nearest A-O Safety Representative show you the *complete* story.

*A-O Safety Goggles*
*Safeguard the Eyes*
*of Industry*

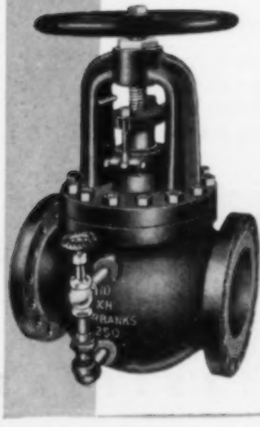
American Optical
COMPANY
*Safety Division*

SOUTHBRIDGE, MASSACHUSETTS
BRANCHES IN PRINCIPAL INDUSTRIAL CITIES

## If you pipe it...there's a fairbanks valve to control it

Here are five typical examples of the outstanding design, sound engineering and rugged construction that are built into every Fairbanks Valve. Years of experience in meeting all kinds of valve requirements for industry, have given Fairbanks Engineers a storehouse of knowledge in controlling the flow of water, steam, gas, oil, chemicals, etc. Consult them without obligation. Just write or call The Fairbanks Company, 393 Lafayette St., New York 3, N. Y.; 520 Atlantic Ave., Boston 10, Mass.; 15 Ferry St., Pittsburgh 22, Pa.; 748 M & M Bldg., Houston 2, Texas.

## American industry flows through fairbanks valves



### GLOBE VALVE

**(Fig. — 0110)**

. . . 250 lbs. steam working pressure; 500 lbs. cold water, oil or gas pressure — non-shock. Extremely rugged iron body, bronze mounted globe valve of the regrinding type. Has ample safety factor to withstand the stresses and strains of high pressure. Bronze stems with Acme threads are of generous proportions for strength and ease of operation. Without removing valve from line, seat and disc may be reground when necessary. Sizes 2" through 12".

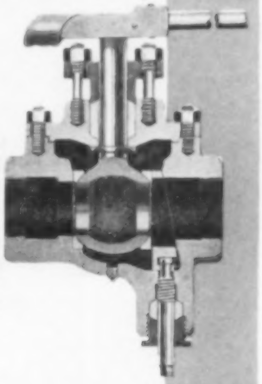
### HUB END GATE VALVE

**(Fig. — 0431)**

. . . 175 lbs. cold water working pressure — non-shock. A non-rising stem gate valve designed for use with Indicator Posts on lines below ground or floor level. Body of semi-steel with high tensile strength, reinforced at all points of strain. Stem of heavy bronze with Acme threads for additional lifting strength and ease of operation. All parts in contact with stem are bronze or bronze lined to prevent corrosion, reduce friction. Sizes 4" through 14".

### IMPROVED "SPHERO" BALL VALVES

**(Fig. — 0850)**



. . . 250 lbs. steam working pressure; 500 lbs. cold water, oil or gas pressure — non-shock. A quick opening valve with full flow. 1/4 turn fully controls valve. Eliminates all easily corroded, threaded parts in line of flow . . . offers less resistance to flow. Cleaning of working parts can be accomplished without removing valve from line. Sizes 1/2" through 8".

### ASBESTOS PACKED COCK

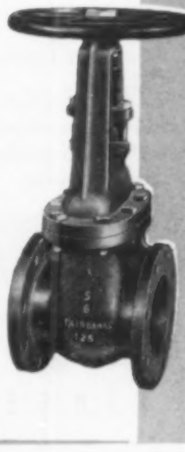
**(Fig. — 0805)**

2-R
FAIRBANKS
GROOVED ASBESTOS PACKED

. . . 125 lbs. steam working pressure; 200 lbs. cold water, oil or gas pressure — non-shock. Grooved, asbestos packed plug cock for boiler blow-off service or controlling the flow of certain acids. Body plug and gland are semi-steel with great strength. Plug is barffed (protected against rust by a special process). Asbestos groove packing is vulcanized . . . provides a smooth, non-galling bearing for the plug. Sizes 1/8" through 6".

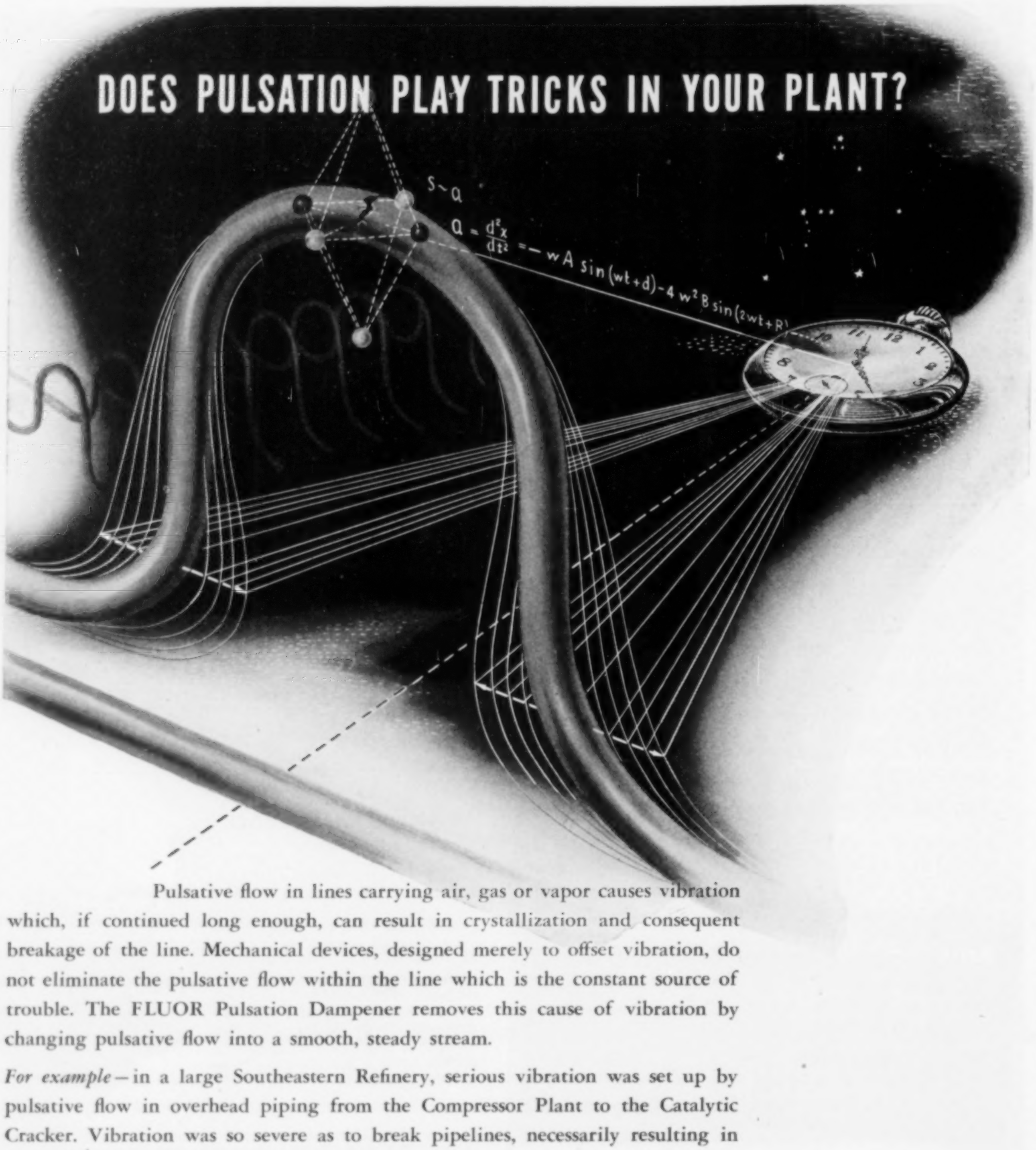
### IRON BODY GATE VALVE

**(Fig. — 0405)**



. . . 125 lbs. steam; 200 lbs. cold water, oil or gas (pressures vary with sizes). Designed for general service on steam, water, gas or oil where unobstructed full flow is desired. Strong construction with reinforcing where required to give extra strength, long, trouble-free life. Bronze mounted, outside screw and yoke, solid wedge, taper seat. Valves may be repacked under pressure when wide open. Sizes 2" through 24".

# DOES PULSATION PLAY TRICKS IN YOUR PLANT?


S ~ a
a = d²x/dt² = −wA sin(wt+d) − 4w²B sin(2wt+R)

Pulsative flow in lines carrying air, gas or vapor causes vibration which, if continued long enough, can result in crystallization and consequent breakage of the line. Mechanical devices, designed merely to offset vibration, do not eliminate the pulsative flow within the line which is the constant source of trouble. The FLUOR Pulsation Dampener removes this cause of vibration by changing pulsative flow into a smooth, steady stream.

*For example*—in a large Southeastern Refinery, serious vibration was set up by pulsative flow in overhead piping from the Compressor Plant to the Catalytic Cracker. Vibration was so severe as to break pipelines, necessarily resulting in shutdown of the equipment. FLUOR Pulsation Dampeners were installed on discharge laterals at all of the compressors, solving the problem by converting pulsative flow into a steady stream.

The FLUOR Pulsation Dampener has no moving parts. It operates with beneficial effects on friction losses, horsepower savings and rate of flow. If vibration plays *tricks* in *your* plant, it may be due to pulsations in air, gas or vapor lines. In that case, the FLUOR Pulsation Dampener is your answer.

## FLUOR PULSATION DAMPENER

fc
SINCE
1890

THE FLUOR CORPORATION, LTD. 2500 South Atlantic Boulevard, Los Angeles 22
NEW YORK • PITTSBURGH • KANSAS CITY • HOUSTON • TULSA • BOSTON

ENGINEERS • MANUFACTURERS • CONSTRUCTORS

# *Economy... Safety... Continuous Operation*

**ALL CALL FOR** TOUGHER CABLES

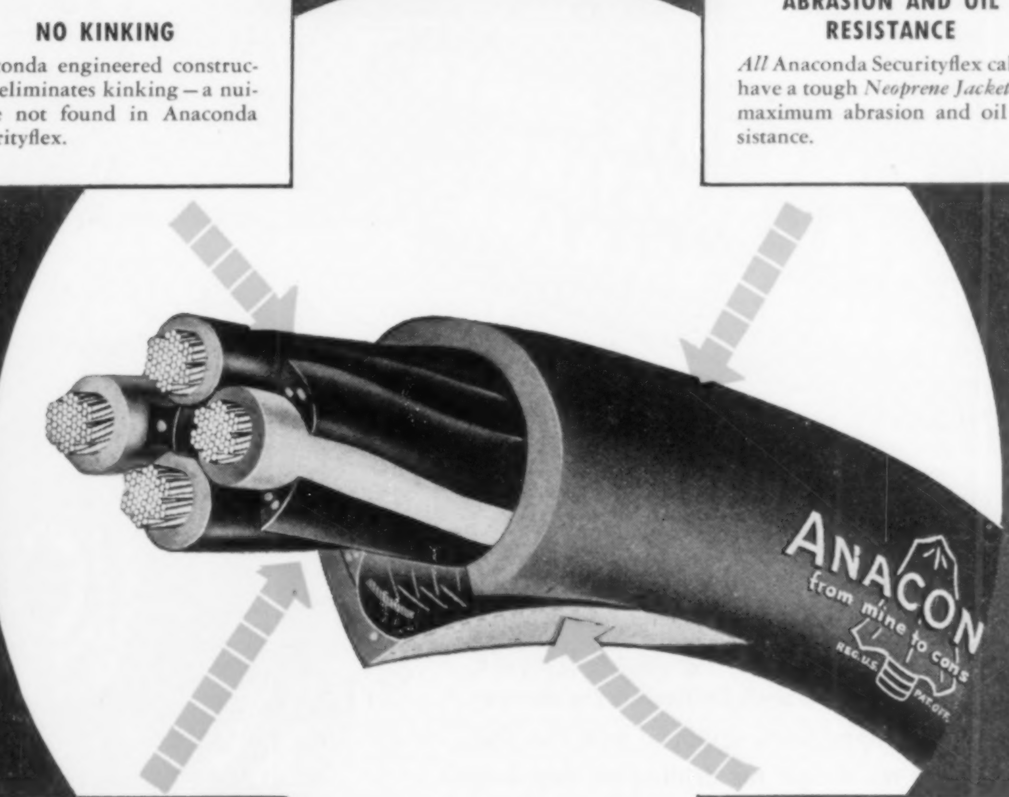
*Here's how to get them* — Look to Anaconda for the sound engineering service and painstaking construction that assures long, trouble-free service — Heavy Duty Securityflex — it's the answer to your cable problems. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, 25 Broadway, New York 4, N. Y. Sales Offices in Principal Cities. 46309

**NO KINKING**

Anaconda engineered construction eliminates kinking — a nuisance not found in Anaconda Securityflex.

**ABRASION AND OIL RESISTANCE**

*All* Anaconda Securityflex cables have a tough *Neoprene Jacket* for maximum abrasion and oil resistance.



**FIRE RESISTANCE**

The specially compounded Neoprene Jacket, plus heat-resistant insulation, makes Securityflex the safest cable possible.

**NO LOOSE JACKETS**

Special bonding process eliminates cable failures from loose jackets.

**ANACONDA *Securityflex** CABLE**

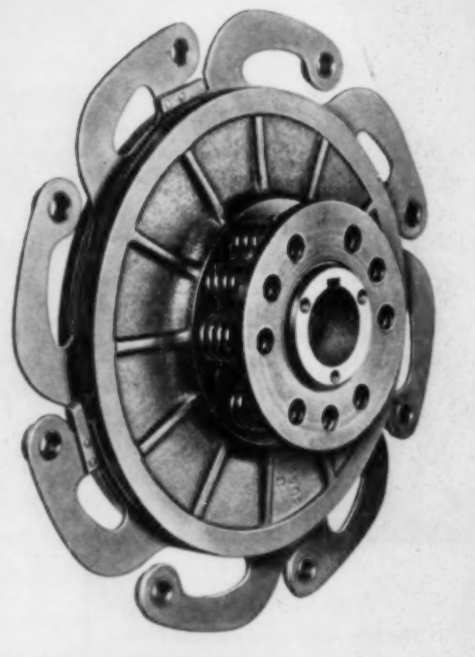
ANACONDA
from mine to consumer

*Reg. U. S. Pat. Off.

A YEAR AGO THIS MONTH WE WERE BLASTING CORAL ON OKINAWA

*U. S. Army Photo*

A lot of groundwork, both literally and figuratively speaking, was being done on Okinawa last August to make it a "spring-board" for our Air Forces in the attack on Japan . . . In the tough job of leveling off coral rock for Futema Airfield, *I-R Mobil-Air* Compressors and *I-R* Wagon Drills were the advance guard. These compressors, equipped with *Flex Disc Clutches,* kept the air on for drilling 20 feet deep holes for charges to loosen the coral so shovels and bulldozers could handle it . . . Indications this summer are for less work on coral islands but for plenty of other tough rock removal jobs for air compressors on construction projects all over the world.



I-R Mobil-Air Compressors are equipped with dependable, low-upkeep *Flex-Disc Clutches.* This is the single disc clutch.

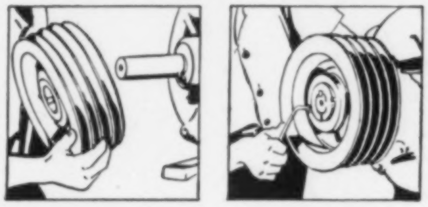
**INDUSTRIAL CLUTCH CORPORATION**

**Waukesha Wisconsin**

# SET THE RIGHT Speed FOR PEAK Production

(ABOVE) TEXROPE Wide-Range Vari-Pitch sheave and V-belts give flexible speed range of almost 2 to 1 on this roving frame in a textile mill. Installation is simple, low in cost. Speed adjustments are easily and quickly made.

## "MAGIC-GRIP" SHEAVE



**GOES ON EASY . . . GRIPS TIGHT**

Patented "Magic-Grip" sheave comes completely assembled. You simply slip it on the shaft (there's easy clearance for even over-size shafts) then tighten three cap screws. Sheave is locked on with a powerful clamp fit — yet it can be removed just as easily. No hammering to damage motor bearings — no filing or reaming. And, no wobble, weave or backlash.

## *TEXROPE Variable-Speed Drives Give Speed Flexibility at Low Cost*

ON MILLS, machine tools, blowers, pumps — wherever changes in speed will add to operating efficiency, output or economy — get the speed flexibility you need with low-cost constant-speed motors and Texrope Variable Speed Drives. There are types to meet all requirements: Vari-Pitch sheaves, for stationary and motion control, Wide-Range Vari-Pitch drives and Speed-Changers.

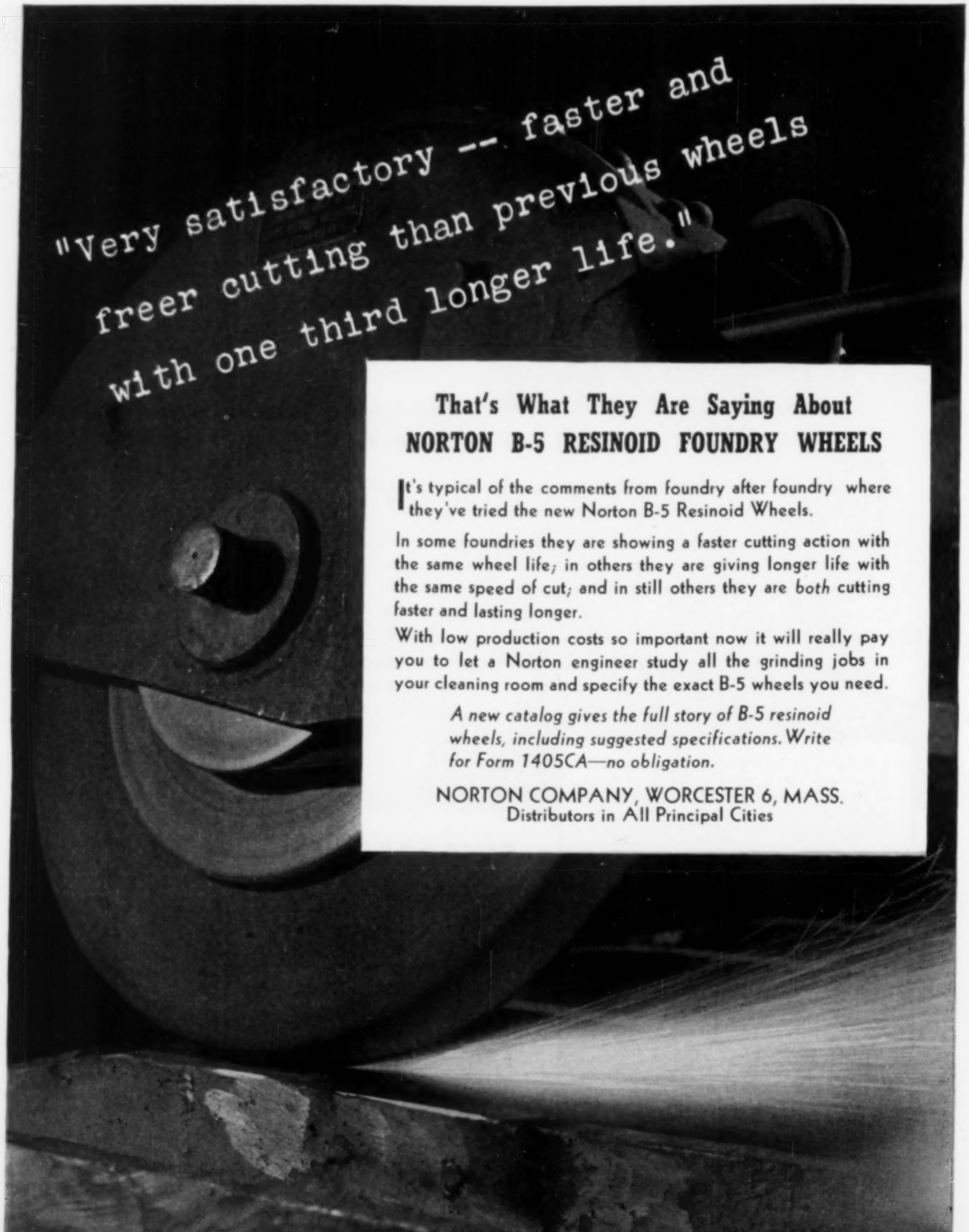
**COMPLETE V-BELT SERVICE:** Your Allis-Chalmers dealer or district office offers TEXROPE "Super-7" V-Belts in five types, all lengths and sections; TEXSTEEL, TEXDRIVE and "Magic-Grip" Sheaves. It's a COMPLETE line of V-Belt equipment, engineered by Allis-Chalmers, originator of the multiple V-Belt Drive. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2084

**ALLIS-CHALMERS**

**One of the Big 3 in Electric Power Equipment —
Biggest of All in Range of Industrial Products**

**TEXROPE
V-BELT DRIVES**


"Very satisfactory -- faster and
freer cutting than previous wheels
with one third longer life."

## That's What They Are Saying About
## NORTON B-5 RESINOID FOUNDRY WHEELS

It's typical of the comments from foundry after foundry where they've tried the new Norton B-5 Resinoid Wheels.

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**NORTON ABRASIVES**

## ON THE COVER

WHEN viewed from some angles, the rock formation pictured on our cover bears close resemblance to a ship—hence its name of Shiprock. It is an igneous intrusion that rises 1640 feet from a sandy plain, making it visible for many miles. Its cliffs are sheer, and it was not climbed until 1939. The landmark is in the heart of the Navajo country, and it has sacred significance to the Indians. Nearby is the Navajo helium project that is operated by the Government and that furnished some of the gas used in our dirigibles during the war.

●

## IN THIS ISSUE

WHEN George Westinghouse proved, in the face of many obstacles, that compressed air was the most suitable medium for braking railroad trains, he unconsciously determined the trend in brakes for heavy automotive equipment, even though the automobile was still several decades in the future. Appropriately, most of the brakes of this type produced in the United States are turned out under the Westinghouse aegis. Also appropriately, the factory that makes them uses compressed air on a wholesale scale to aid its operations. Our leading article gives the details.

●

NEW MEXICO, with two and one-half times the area of New York State, averages only about five inhabitants per square mile. It has abundant mineral resources, but lack of a home market has impeded the development of industries based upon them. Wartime demands for some of these raw materials boomed their production temporarily, and New Mexicans tasted prosperity. In an effort to keep it, they are exploring the possibilities of processing some of their minerals and shipping the products to neighboring states whose combined population runs into many millions. Our second article gives a general picture of the nonmetallics that await exploitation.

●

WAR is inevitably wasteful, and when the fighting ends as suddenly as it did in World War II a vast amount of used and unused material loses most of its value overnight. Much of it must be junked, but some of it can be profitably reclaimed if salvage operations are properly organized. Our third article tells how the Navy sifts thousands of returned articles to retrieve a modicum of the taxpayer's money.

# Compressed Air Magazine

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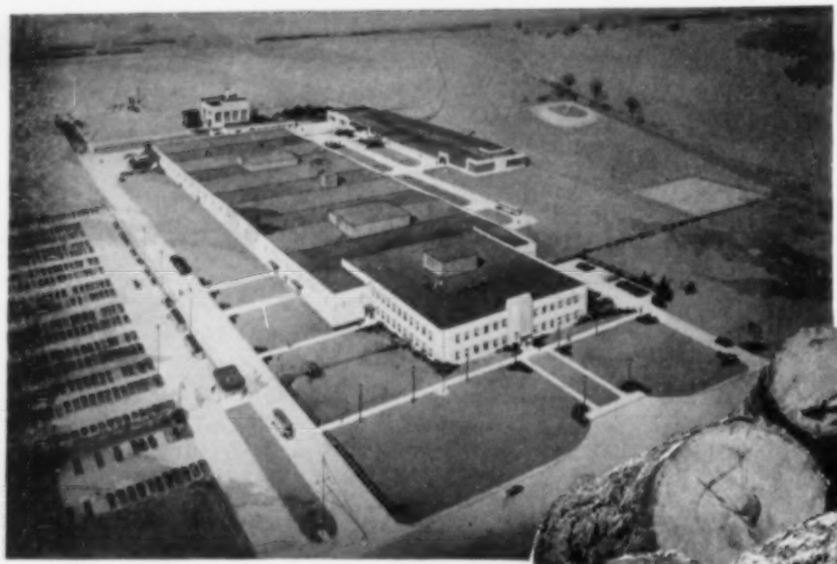
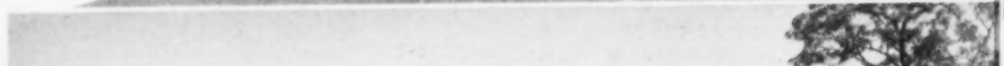


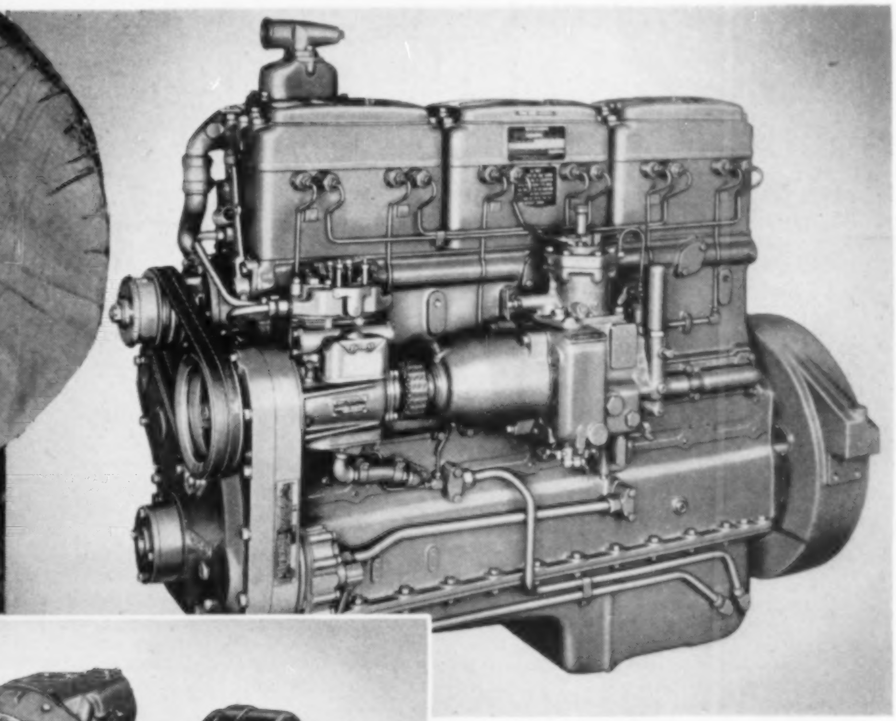
# AUTOMOTIVE AIR BRAKES

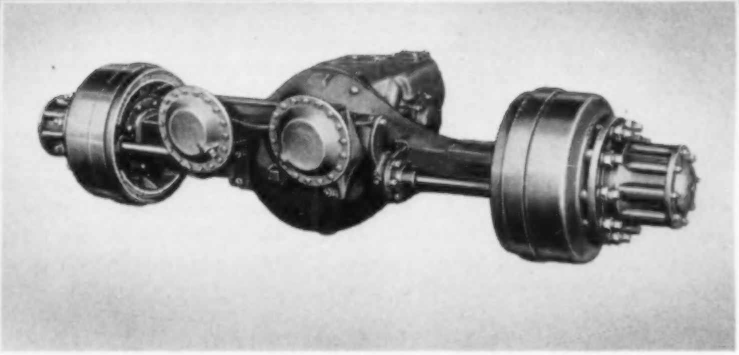
*C. H. Vivian*

MOST motorists have acquired a wholesome respect for the rapidity with which air power acts to bring fast-moving heavy highway vehicles to a quick stop. An experienced driver never creeps up too closely on a bus or a truck that is traveling on the level or downhill, lest the leading car halt so suddenly that he will be unable to prevent his own machine from crashing into it. But, for the benefit of the brash or unwary, many of these commercial vehicles still display at the rear an admonitory message such as "Caution—Air Brakes."

Power brakes are an outgrowth of the increase in size and speed of automotive vehicles. Early cars of all types had mechanical brakes that were applied on only the rear wheels. When faster running called for greater braking power, 4-wheel brakes were adopted. Although trucks were then comparatively small, an operator practically had to lock the wheels to make a quick stop when going at a fair rate of speed. This called for pressure on the pedal that was beyond the strength of the average man, so power brakes were developed. Now the heaviest vehicle on the road can be brought to a quick and effective halt with little more exertion







**AIR-BRAKE MISCELLANY**

In an air-conditioned factory near Elyria, Ohio, (extreme left), Bendix-Westinghouse Automotive Air Brake Company produces most of America's brakes for heavy-duty vehicles. These brakes provide safe control for passenger buses and trucks, including multiple-trailer units such as are used in the logging industry. Compressed air comes from a compact compressor driven by power take-off from the vehicle's engine. The view below shows an 8-cfm. unit mounted on a Cummins 6-cylinder, 150-hp. diesel engine, with piping connections to receive cooling water and lubricating oil from the engine's systems. The braking force is applied to each vehicle wheel by a small brake chamber somewhat similar in appearance to two saucepans put together top to top. A pair of them is at the rear of the truck axle pictured below the engine.

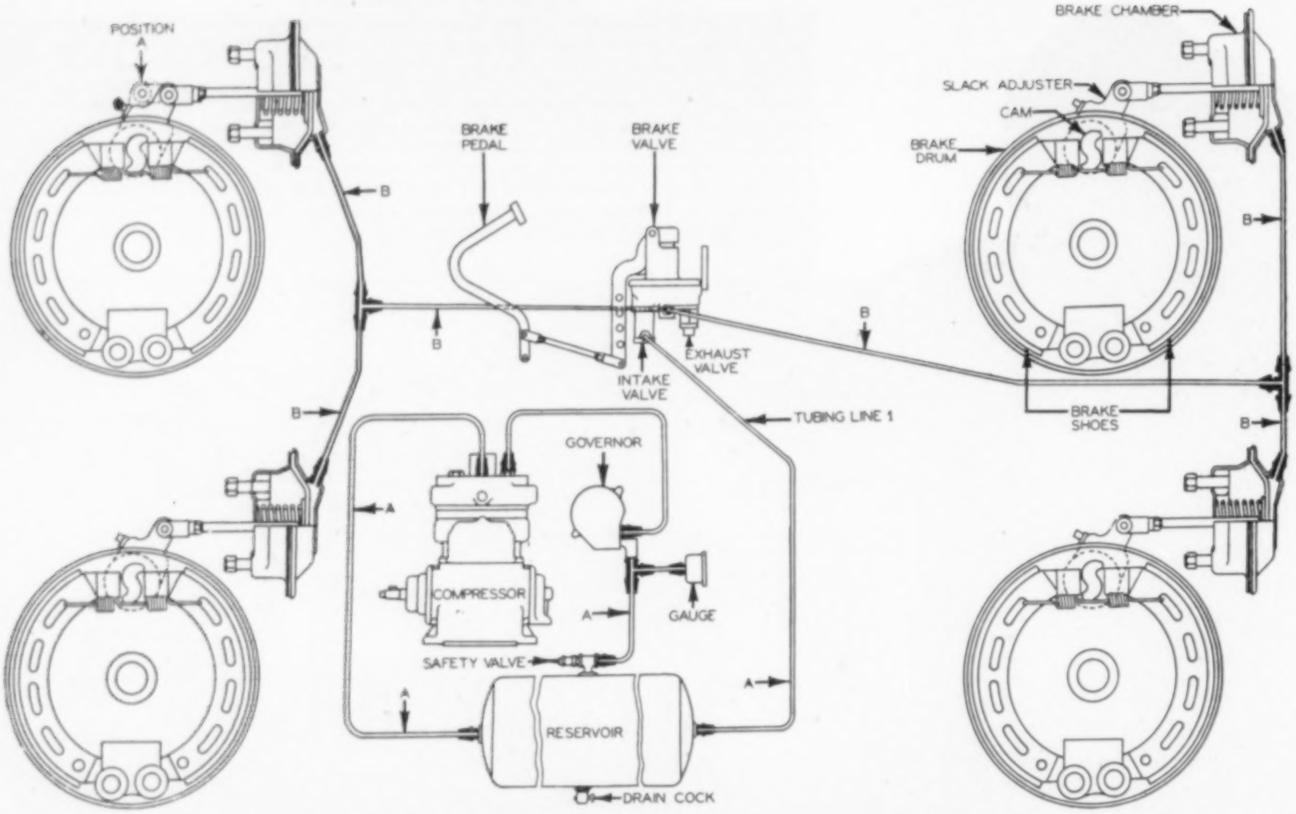
than it takes to depress the accelerator of a passenger car.

There are two types of heavy-duty power brakes, both of which are actuated by the force of air. The so-called vacuum brake works on the principle of Newcomen's atmospheric engine. Suction induced by the intake manifold of the propulsion engine creates a partial vacuum on one side of a piston enclosed in a cylinder. The pressure of the atmosphere on the opposite side moves the piston and thus exerts a pull on connectors linking it with the braking mechanism. Vacuum brakes are used on light trucks up to around 2½ tons capacity. Heavier trucks and buses require more braking power, and this is obtained by means of compressed air.

The automotive air brake is a direct lineal descendant of the railroad air brake that first brought fame to George Westinghouse. Although Westinghouse did not live long enough to have a personal hand in its development, it was brought into being by one of the companies he founded, and nine out of every ten brakes of this type now made in the United States are produced by a concern with which his name is still linked. It originated in 1920 at Emeryville, Calif., in the plant of the Westinghouse Pacific Coast Brake Company, a subsidiary of the Westinghouse Air Brake Company of Pittsburgh, Pa. At that time motor vehicles were growing in size, weight, and speed, and these factors, coupled with the increasing number of cars, created a need for a more positive method of controlling them. To meet it, the engineering staff at Emeryville, working under the guidance of the plant manager, S. G. Down, set about devising a power brake. Inasmuch as compressed air had been found to be the best operating medium for railroad brakes, it was only natural that it should be applied to motor vehicles.

Strictly speaking, the first automotive brakes utilized a mixture of air and gasoline vapors, for the car's own engine served as the compressor. Some of the gaseous charge was bled off from one or more of the cylinders toward the end of the compression stroke and stored under pressure to be drawn upon as required. After a period of testing, the new brake was offered to the trade on February 16, 1921. The first ones were used on big touring cars, but since then they have been applied almost exclusively to trucks, buses, and other heavy-duty equipment. The first application of the latter kind was made in the spring of 1921 on fire-fighting apparatus of the Borough of Wilkinsburg, a suburb of Pittsburgh. Others followed quickly, and were so successful that regular production of the brake was started in the shops of the parent Westinghouse Air Brake Company at Wilmerding in the Pittsburgh area. The demand grew steadily, and activities were soon segregated in a separate unit of the concern, called the Automotive Division, with its own shop and sales office.

Westinghouse Air Brake Company's principal business always had been with railroads, and it did not have adequate sales outlets to cover the automotive



**BASIC BRAKING-SYSTEM DIAGRAM**

This drawing illustrates the standard brake equipment and the fundamental operating principle that remains the same even when additional devices are used. The *A* air lines are under pressure at all times. When the brake pedal is depressed, the brake valve admits air to the *B* lines that feed the braking equipment. When the pedal is released, the intake port of the brake valve is closed, thereby again confining the pressure to the *A* lines. At the same time, the air in the *B* lines and the brake chambers is released through the exhaust port of the valve.

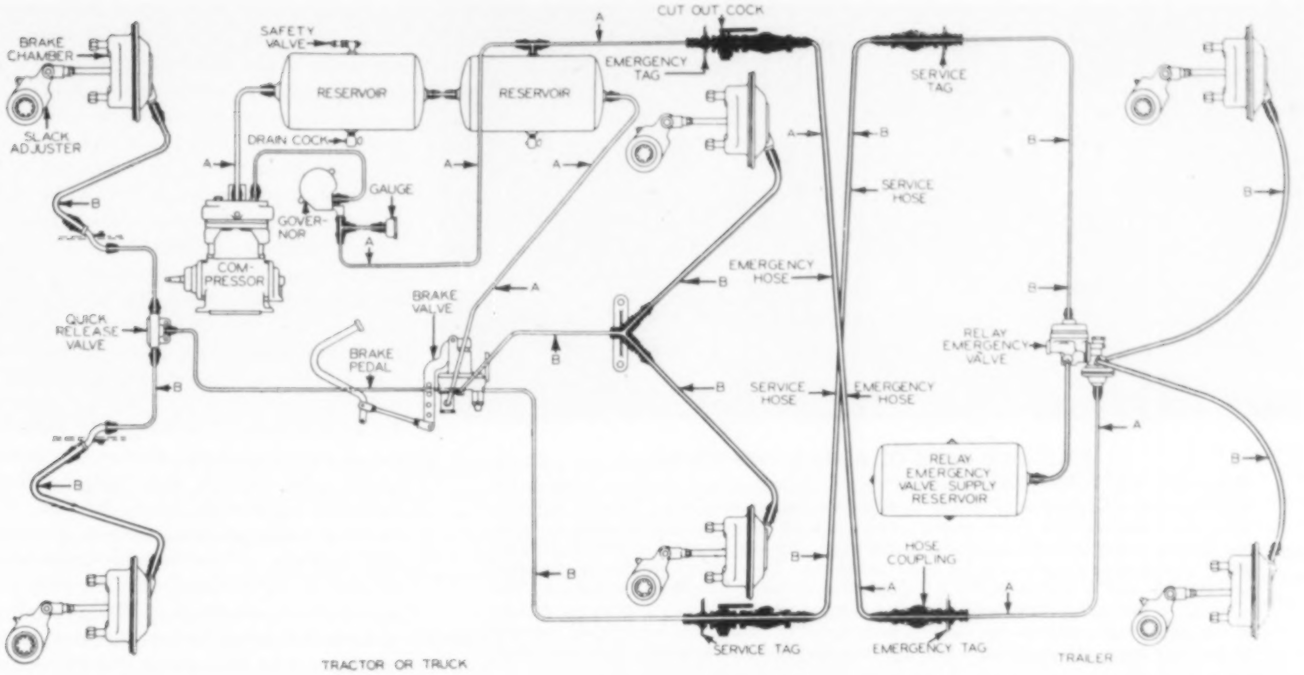
field efficiently. Accordingly, to improve merchandising of the brake, a new company was formed in 1930 in conjunction with the Bendix Aviation Corporation, which was already making several products for the automotive trade and had built up a sales organization for marketing them. The new firm was called the Bendix-Westinghouse Automotive Air Brake Company. Manufacturing operations were carried on at Wilmerding as a division of the Westinghouse concern until June, 1941, when a new plant was occupied at Elyria, Ohio, about 25 miles from Cleveland.

The basic principle of the original air-brake system is still retained, but there have naturally been many additions, refinements, and improvements to keep pace with the steady development and increasing carrying capacity of heavy-duty motor vehicles. One of the early major changes was the substitution of compressed air for the engine gases. This came about with the introduction of a small compressor that could be driven by the vehicle's engine. During the intervening years, compressed air has come into service on trucks and buses for purposes other than braking. The company has originated some of the devices concerned, and has broadened its line to include pneumatic gear shifts, clutches, steering mechanisms, throttles, etc. It also makes an air-operated horn. These developments, plus the need for progressively more braking power for the safe control of larger and larger vehicles, have demanded compressors of additional sizes, and they are now built in three sizes.

Most air brakes are installed on vehicles while the latter are being assembled in the factories where they are made. They are planned in detail by the respective manufacturers' engineers, and are naturally designed in each instance to meet the requirements of the particular type and size of car on which it is placed. Other brakes are put on vehicles after they are in service and are known as field installations. Distributors of braking equipment in various parts of the country maintain forces of factory-trained mechanics to do this work. In recent years air brakes have been applied to various classes of contractors' vehicles other than trucks, such as earth-moving units used on heavy construction jobs. These are called "off-the-road" vehicles. Virtually all the brake equipment made during the war went on military vehicles. Most Army trucks and many gun carriages were equipped with them. Many tanks included compressors and air-distribution elements because they were frequently used for towing vehicles that had air brakes but no source of power for driving a compressor.

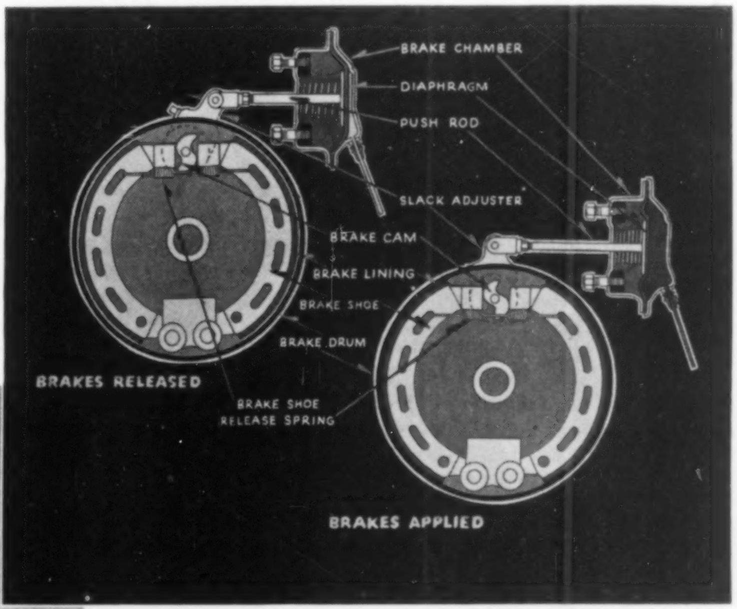
In its simplest form, the air-brake system consists of a compressor, air-distribution lines, governor, pressure gauge, safety valve, reservoir, brake valve, and brake chambers. Compressed air is conveyed through copper tubing to a storage reservoir from which it is withdrawn as needed to apply the brakes, which are operated by a treadle valve that looks and functions much the same as the conventional foot accelerator or pedal such as is used in actuating mechanical brakes. When a driver depresses the pedal, air is admitted to the lines supplying the braking devices. This is accomplished through the action of the brake valve which has an intake and an exhaust section. The intake is normally closed, preventing the "pressurized" air from going beyond that point. The exhaust valve is normally open, thus making sure that there is no pressure in the lines extending to the braking elements. When the pedal is depressed the intake is opened, the exhaust is closed, and compressed air immediately flows to the braking devices. When the pedal is released, this sequence is reversed—the compressed air in the afterpart of the system is exhausted to atmosphere and the pressure is again confined to the forepart.

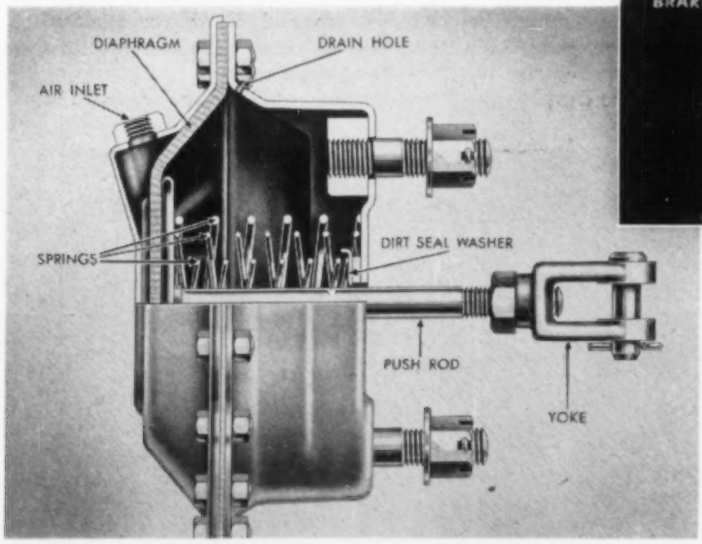
Actual application of the brake is made by the brake chamber, the construction of which is shown in an accompanying illustration. Pressure of compressed air upon a diaphragm serves to move the lat-


BRAKE CHAMBER
SLACK ADJUSTER
SAFETY VALVE
RESERVOIR
RESERVOIR
DRAIN COCK
GAUGE
GOVERNOR
COMPRESSOR
QUICK RELEASE VALVE
BRAKE VALVE
BRAKE PEDAL
CUT OUT COCK
EMERGENCY TAG
SERVICE TAG
SERVICE HOSE
EMERGENCY HOSE
SERVICE HOSE
EMERGENCY HOSE
RELAY EMERGENCY VALVE
RELAY EMERGENCY VALVE SUPPLY RESERVOIR
HOSE COUPLING
SERVICE TAG
EMERGENCY TAG
TRACTOR OR TRUCK
TRAILER
A
B

**BRAKING CONTROL FOR TRAILER**

The diagram above illustrates one of the various arrangements of the equipment available for tractor-trailer units. Two brake valves are used, one being controlled by the foot pedal and the other one by hand. The foot-operated valve applies the brakes on both tractor and trailer, while the hand-operated valve applies only the trailer brakes. This system enables a driver to brake the trailer independently of the tractor. It increases his control of the trailer when descending hills and under wet or icy road conditions and minimizes the possibility of jackknifing. The diagram also shows a relay emergency valve which serves two purposes. Under normal conditions the valve speeds up the action of the trailer brakes by drawing the air directly from a separate reservoir. Under emergency conditions, such as a trailer breakaway, the valve will automatically apply the trailer brakes.


BRAKE CHAMBER
DIAPHRAGM
PUSH ROD
SLACK ADJUSTER
BRAKE CAM
BRAKE LINING
BRAKE SHOE
BRAKE DRUM
BRAKE SHOE RELEASE SPRING
BRAKES RELEASED
BRAKES APPLIED

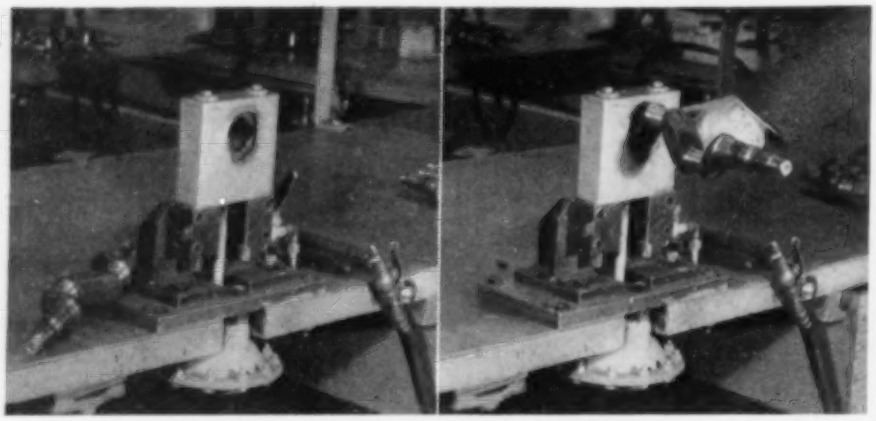

DIAPHRAGM
DRAIN HOLE
AIR INLET
SPRINGS
DIRT SEAL WASHER
PUSH ROD
YOKE

**BRAKE CHAMBER AND METHOD OF OPERATION**

The partial cutaway (left) shows the construction of the brake chamber, while the other view indicates how it applies the braking force. Air pressure entering behind the diaphragm moves the latter forward and with it a push rod. The rod rotates the slack adjuster, brake camshaft, and brake cam, thereby pushing the brake lining against the brake drum. When the air is exhausted from the brake chamber, springs return all the elements to their original positions and the brake is released. The brake chambers are made in seven sizes with effective diaphragm areas varying from 6 to 36 square inches. Using air at 60 pounds pressure, the force they develop ranges from 360 to 2160 pounds. The diaphragm is made of oilproof rubber and fabric.

ter forward and with it a push rod, the outer end of which is connected to the wheel brake by means of an arm known as a slack adjuster. Movement of the slack adjuster rotates a cam and thus forces the brake shoes against the brake drums. When the air pressure is exhausted, springs acting on the brake-shoe cam and one in the brake chamber return all the moving elements to their original positions, releasing the brake.

The time required to stop a vehicle from a given speed depends upon how the brakes are applied. If the pedal is depressed slightly, the brake valve delivers only low-pressure air to the brake chambers and, as the air has an opportunity to expand somewhat, the maximum reservoir pressure is not exerted in them. On the other hand, if the pedal is suddenly pushed clear down, full reservoir pressure rushes to the brake chambers and the brakes are set with full force. The best possible stop will be made when a brake is first applied



FACTORY USES OF BRAKE CHAMBERS

More than 500 standard air-operated brake chambers are used on fixtures for holding and clamping duty in the Bendix-Westinghouse plant. Typical applications are illustrated on these pages. The pictures are arranged in pairs to show the fixture unloaded and loaded in each case. Shown above is a vise that holds small compressor crankshafts for hand polishing. The brake chamber is mounted underneath and is controlled by a 2-way valve at the right side of the fixture. The operator must change the position of the crankshaft many times during the course of the polishing, and this can now be done quickly. This fixture saves 25 percent of the time formerly required when a conventional hand-operated vise was used.

as hard as speed, road conditions, and passenger comfort permit and is then graduated off as speed is reduced so that little pressure is being exerted as the stop is made. If the brakes are applied lightly and then more heavily as speed diminishes, a jolting stop will result and stopping time will be increased. In many instances an experienced driver takes advantage of the retarding effect of the engine to slow down his vehicle before applying the brakes, and it is claimed that a good operator uses air brakes less than he does mechanical brakes.

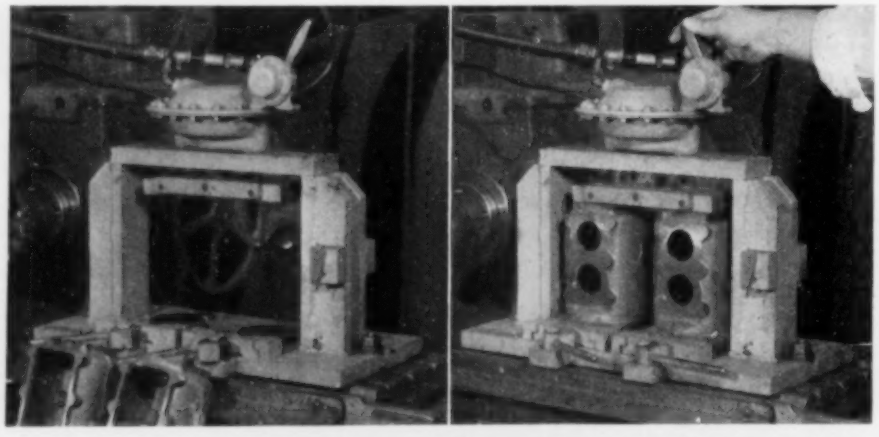
The governor automatically maintains the reservoir air pressure within a predetermined range, which is usually 80 to 105 pounds. (Effective braking requires as little as 20 pounds pressure.) When the pressure reaches the upper limit, unloader valves on the compressor are opened. Conversely, when the pressure drops to the lower limit, the unloader valves are closed. The safety valve is mounted on the reservoir and is designed to function in case the pressure should go up to 150 pounds. The gauge is on the dash in the driver's cab and affords a means of checking the reservoir pressure at all times. Should it fall below 50 pounds while the vehicle is traveling, a device known as the low-pressure indicator warns the driver by signal light, buzzer, or both, that he should stop and investigate.

The equipment just enumerated constitutes the standard brake system and the minimum requirement for the safe operation of an ordinary truck of small or medium size. Various additional devices are either desirable or necessary for larger trucks or buses and for tractor-trailer units. Even when they are employed, however, the fundamental operating principle remains the same as that outlined. In most cases there are two interconnected air storage reservoirs. This arrangement not only adds reserve power but also permits the first receiver to trap moisture, which condenses and can be periodically drained off by opening a pet cock at the bottom. Supplementary devices often used on trucks and buses are: a low-pressure indicator, an air-supply valve, a relay valve, a quick-release valve, a stop-light switch, and a limiting valve.

The low-pressure indicator automatically causes a warning mechanism to function when the reservoir pressure is less than the effective minimum for continuous brake operation. The air-supply valve, interposed in the line between the compressor and the governor, permits air to be withdrawn for emergency tire inflation and other purposes and causes the compressor to run all the while the air is being used. The relay valve speeds up the operation of the rear brake chambers. As it is actuated by only a small amount of air admitted from the brake valve, it functions when the brake pedal is depressed but slightly. In turn, the relay valve admits a greater volume of air from a reservoir into the lines feeding the rear brake chambers. It also speeds up the release of the brakes by causing the air in them to be discharged directly to atmosphere instead of following the normal and more circuitous route through the brake valve. The quick-release valve acts in a similar manner to discharge air from the brake chambers. The stop-light switch—an electro-pneumatic device—instantaneously operates the stop light upon the slightest application of the brakes. The limiting valve enables a driver to control the braking power of the front-wheel brakes in accordance with varying load and highway conditions. When running a vehicle unloaded or on slippery or icy roads, he may, by setting this valve, limit the air pressure admitted to the front brake chambers so that the braking force will not cause the wheels to slide.

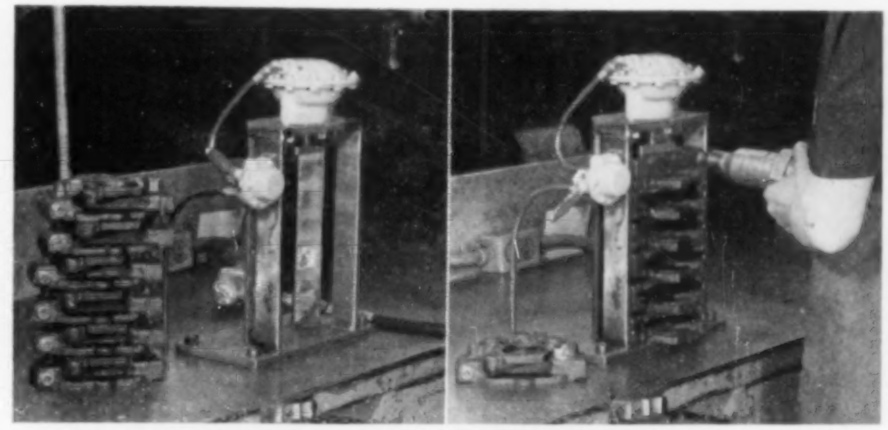
When auxiliaries such as a horn, windshield wiper, clutch, etc., are actuated by air, an auxiliary reservoir may be added to serve them. This precludes the possibility of the pressure in the regular receiver being reduced by them below the requirement for safe braking. Incidentally, records indicate that vehicles equipped with air-operated horns and windshield wipers make better time than others during storms or in heavy traffic. Apparently the air horn can be heard farther ahead than other types, while the action of the wiper is sure and effective, thus affording the best possible vision under adverse weather conditions.

Additional devices are usually intro-



CRANKCASE MILLING FIXTURE

A quarter-turn of the valve handle operates the brake chamber and the latter holds the pieces in position for milling by a Cincinnati duplex hydro-matic milling machine. With the bar-type fixture that was formerly used it was necessary to hand-tighten two nuts with a wrench. Then the allowed handling time per piece was 0.623 minute; now it is 0.176 minute. The air clamp grips the parts firmly and prevents chatter and slipping while they are being milled, whereas under the old conditions there was occasional cutter breakage because the bar was not drawn down tight enough to hold the parts in place.



**HOLDING FIXTURE FOR CYLINDER HEADS**

This fixture doubled the production rate of inserting ½-inch pipe plugs in small compressor cylinder heads. Seven heads are now clamped in position for the operation instead of handling them one at a time as was the case when a conventional vise was used. This eliminates six pickups of the air tool with which the work is done, as well as tightening and loosening the vise for each piece.

duced on tractor-trailers. When the tractor and trailer are used as a unit, the air-line connections between them are flexible hoses with couplings that may be easily disconnected by the operator but that will not become disengaged otherwise. The brakes on both are applied simultaneously by depressing the brake pedal. There are cutout cocks that are closed when the trailer is not in service so that the tractor brakes continue to function.

The compressors furnished with the Bendix-Westinghouse brake system are high-speed, single-acting, reciprocating units having either two or three cylinders. As the compressor is mounted underneath the vehicle hood, compactness is important and the machines have been designed accordingly. The trucking industry is becoming more and more concerned about reducing extraneous weight to a minimum and, consequently, there is a tendency to use aluminum wherever possible in compressors.

Being driven by the vehicle's engine, the compressor works all the time the engine is operating. Even though it is running without load a large part of the time, the duty is heavy for a small compressor and it must therefore be built carefully and of high-grade materials. Nevertheless, present production is at the rate of many thousands a month. Water-cooled units predominate, and are connected with the circulating system that serves the vehicle engine. Air-cooled machines are used principally where brake installations are made in the field.

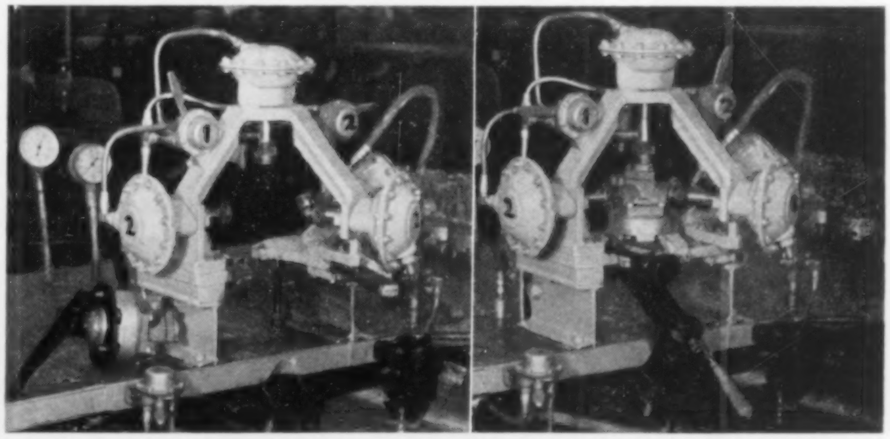
Most compressors also are lubricated from the engine's oiling system, but those made for certain automotive manufacturers and for field installation where there are no provisions for mounting them are provided with a built-in oil pump. Ratings of discharge capacity are based on an operating speed of 1250 rpm. Speeds higher than 1800 rpm. are not recommended. To exclude road dust and other grit, the intake air is passed through a strainer filled with pulled, curled hair. The company has a flat-rate repair exchange service that enables a customer to return a compressor, as well as other units of the system, to the factory periodically for overhaul or rebuilding. It is replaced by a factory-reconditioned unit that bears the same guaranty as new equipment.

The plant at Elyria consists of four buildings. The main structure—housing offices, machine shops, and assembly, tool, and shipping sections—is heat, light, and air conditioned. The company buys rough castings and forgings made to its specifications and performs whatever subsequent operations they may require. There are approximately 1400 employees.

Bendix-Westinghouse is definitely an air-minded concern. It not only produces pneumatic appliances but also uses compressed air extensively in making them. In fact, it is doubtful if there is another manufacturing establishment of its size that can count as many individual applications of air power as can this one. Inasmuch as the motive of the company, like others, is profit, it must be evident that there are sound financial reasons for this widespread utilization of compressed air. The truth is that it has enabled the firm to make substantial monetary savings and also to derive other benefits that will be mentioned later.

The turn to air power has been cumulative—it has grown by its own momentum, like a snowball rolling downhill. When the first applications of compressed air worked out favorably, others followed, and when they also proved advantageous it was only natural that a systematic search should be made for other places where air power could be gainfully adopted. This has not been a hit-or-miss program. A careful study has been made in each instance before changing the existing method of operation. The investigations are carried on regularly by the Tool and Methods Department of the factory and call for close scrutiny of all the factors involved. The data assembled include time studies, reactions of employees to the proposed innovations, safety considerations, etc.

Naturally, many of the changes made on the department's recommendation do not concern air equipment. Also, in numerous other cases the adoption of air power is only one phase of the revamping of manufacturing means or methods. It so happens, however, that compressed air has been applied to advantage in so many instances that it is unquestionably



**FIXTURE FOR TREADLE-TYPE BRAKE-VALVE TEST**

This set-up was devised to facilitate testing a treadle-type air-valve assembly for leakage and correct operation. The top brake chamber, actuated by No. 1 Valve, holds the part securely during the test. Three chambers arranged around the sides and operated by No. 2 Valve advance plungers to close ports on the treadle-type valve. The steady pressure they exert provides an airtight seal and insures a thorough test. The 2-way valve on the bench (lower left) admits air to determine leakage. Another valve admits air to a cylinder that actuates the pedal of the valve under test to simulate actual service conditions. Formerly, fittings had to be screwed to the part manually and other fatiguing operations were involved. Savings amount to 2.6 cents per valve tested.

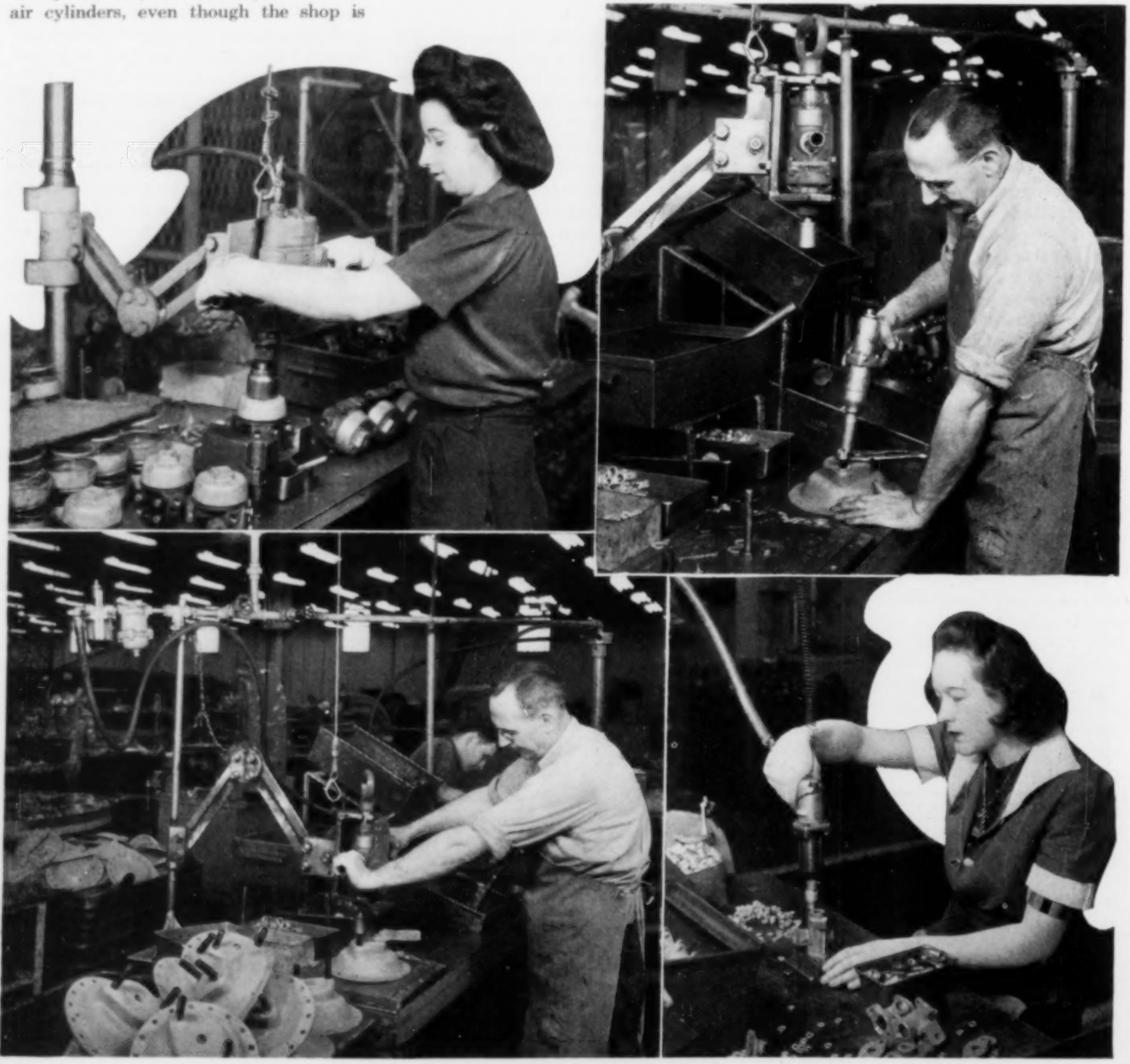
the outstanding feature of the entire program. It has aroused much prideful interest among the company's management personnel because the predominating pneumatic device used in the factory is the brake chamber that is produced there as an essential part of the automotive air brake. This piece of equipment serves the same purpose as an air cylinder, but has been found to be preferable to it for work within the range of its capacity. The maximum stroke of the largest standard brake chamber is 2½ inches, and this has been found to be sufficient for all but a minor fraction of the applications. Wherever greater piston movement is required, air cylinders are employed.

Although they naturally leaned towards their own product, the methods engineers had sound business reasons for their choice of brake chambers. In the first place, they are less expensive than air cylinders, even though the shop is charged the same price that they bring through regular trade channels. Brake chambers also have advantages from an operating standpoint. Their diaphragm construction prevents leakage of air, and the absence of packing around the piston eliminates the friction inevitable in air cylinders. Because of these two features, maintenance problems all but vanish. Brake chambers have an average service life of a million cycles of operation. Although some have been used on fixtures continuously since 1941, the first failure of one of them is yet to be recorded.

The application of brake chambers in the factory has grown steadily until more

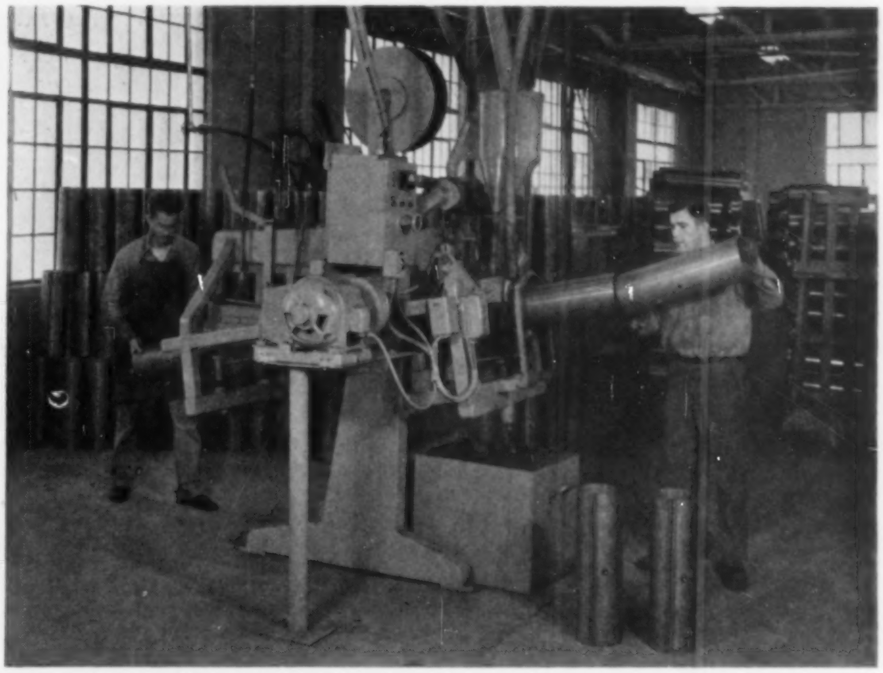
**PNEUMATIC-TOOL APPLICATIONS**

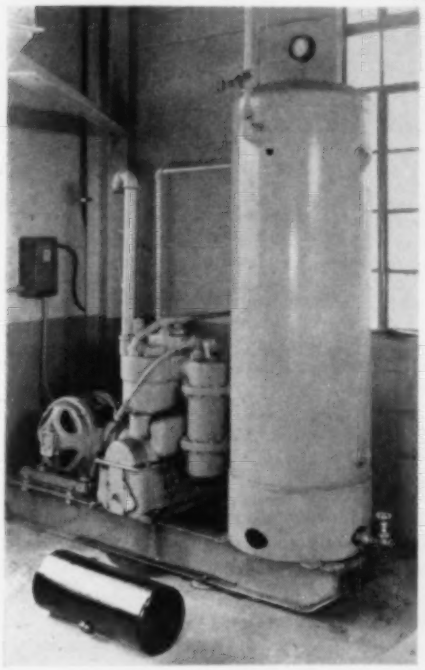
Pneumatic tools not only speed up various assembly operations but also make them easier to perform. In many instances, special holders and fixtures have been developed to save time and physical effort. The views at the top-right and bottom-left show a worker using two different tools at the same station. In the first one he is setting ⅝-inch studs in the nonpressure plate of a brake chamber with a Size 504 impact wrench. In the lower one he is running hexagonal nuts on the studs with a reversible multi-vane drill. Note the moisture separator and lubricator in the air line at the upper-left. The drill is mounted on a holder that keeps it vertical whether it is raised or lowered. When not in service, the holder is elevated out of the way, as seen in the companion picture. The girl at the top-left is operating a similar multi-vane drill. She is screwing a cover with a 3⅜-inch-diameter thread on a relay valve. The one at the bottom-right is using a Size 502 impact wrench to drive two 5/16-inch threaded bolts in assembling a double check valve.



### FABRICATING RESERVOIRS

The size of the air reservoir for the brake system varies with the size of the vehicle, the average being 7x36 inches. The shell is made of rolled steel with a welded seam, and pressed-steel heads are welded on it. The picture at the right shows a continuous seam welder for the shells. Each reservoir is coated inside and out with black-enamel paint and tested under 250 pounds pressure. Air for this purpose is furnished by the Ingersoll-Rand Type 20 compressor seen below. In front of it is a finished reservoir.





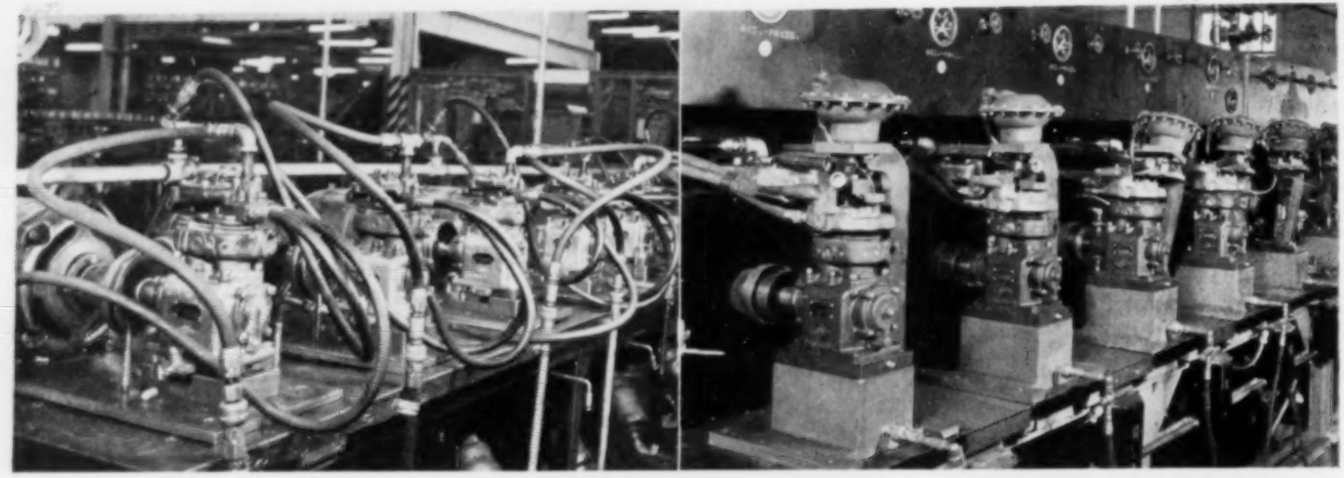
than 500 of them are now on some 400 separate fixtures. Although the saturation point is being approached, additional installations are being made. Most fixtures require only one, but a considerable number has two or more. The majority of the chambers are used in machining operations, but many are found in the assembly and testing sections. Typical examples of their services are described in connection with some of the accompanying illustrations. The chambers are actuated by control valves, which are usually of a simple rotary disk type. These valves, like the brake chambers, are standard parts made in the plant.

Early this year a time study of approximately 25 percent of the air-controlled fixtures disclosed that they were reducing costs at the rate of many thousands of dollars a year, and it has been increased since then through additional air-chamber applications. The cost of the air controls on the fixtures surveyed was only $2341, or a small fraction of the indicated annual saving.

The monetary saving has come about chiefly by lowering the labor costs that prevailed when manual or mechanical controls were in use. In some instances the labor charge per operation has been cut in half by reducing the time requirement. This has made it possible to transfer some employees to other work, but has displaced no one from a job. Employees have been generally receptive to the program, for in numerous cases the air controls have transformed arduous tasks into easy ones, and some operations that formerly called for men are now done by women. The program has also improved the plant safety record. Because an air clamp always exerts the same pressure, accidents have been eliminated that were formerly caused by a cutting tool striking a part that had been under- or overtightened by hand. There has thus far been no mishap that could be attributed to the improper functioning of an air chamber. The stable holding pressure also has done away with losses that were occasionally sustained through breakage of parts by overtightening them in fixtures.

The use of compressed air on fixtures has been supplemented by pneumatic tools, which have been adopted by the company wherever studies showed they would profitably speed up operations or render them easier to perform. Most of the tools are wrenches of various types and sizes that run on nuts, set studs, etc. Thread sizes of the pieces handled by them range from ⅝ inch up to 3⅜ inches. Some of these tools are the new lightweight aircraft models that came into widespread service during the war. Others are the heavier units that have long been standard in many industries. In nearly all instances they are either mounted on special holders or suspended from overhead balancers. These aids make them readily accessible when needed and also lessen operator fatigue by supporting some of the weight of the heavier tools while they are in use. Obviously, on repetitive operations of the type that prevail in the plant, they save a great amount of time during the course of a shift. Selected examples of pneumatic-tool applications are shown in accompanying pictures.

Compressed air is used at various pressures and is supplied from four separate sources. For general plant purposes, air is compressed to 125 pounds pressure by a steam-driven 2-stage machine having a discharge capacity of 876 cfm. It is passed through an aftercooler that extracts moisture and reduces its temperature to approximately 108°F. This air is drawn upon to operate the brake chambers on the fixtures, as well as the pneumatic tools; it is fed to blowguns to remove metal turnings, etc., from machine tools, although this application is discouraged in certain cases because the air scatters the particles and may cause some of them to lodge in wearing parts of the machines; and it also actuates the controls of the air-conditioning apparatus. The shop distribution system consists of a 5-inch overhead line with 1¼-inch take-offs to the various machines. There are between 250 and 300 of these drop lines, and some of



**COMPRESSOR TEST RACKS**

Every compressor built in the plant is given a 1-hour running test under load before it is approved for shipment. Improved test racks have recently been designed and built by the company's own engineers, and in these pictures the new and the old fixtures are contrasted. With the old set-up (left), heads had to be bolted on each machine and the compressor itself secured to the base. An annoying jungle of hose connections had to be contended with. In the case of the new racks (right), a head is clamped on and the entire mechanism is held rigidly by a brake chamber at the top that swings over into proper position. Hose connections come in at the rear and are out of the way. The various readings required are taken from gauges on the panel. There are two of these new racks, each with places for twenty compressors, whereas the old fixtures accommodated fifteen. The ease and rapidity with which machines can now be set up enables one man to attend each new rack, whereas two were needed for each old one.

them serve as many as fifteen fixtures each.

Indicative of the relatively small volume of air that is required by the 500-odd brake chambers is the fact that the original compressor plant has thus far been able to take care of them even though they were not contemplated when the factory was constructed. However, in order to assure an adequate reserve air supply and to provide for future increases in air consumption, another machine with a capacity of 600-cfm. has been ordered.

**BRAKE-CHAMBER ASSEMBLY**

Here the various components of brake chambers are put together to form complete units. There are twelve stations on the circular table, which rotates at a predetermined rate to move the work along to the operators. Beyond the girl at the left may be seen one-half of a brake chamber with studs projecting upward. The one in the background puts on the other half, which has been preassembled, and starts the nuts on the studs. The operator at the right runs on the nuts with a Size 504 impact wrench, and the one at the left removes the finished work. These chambers are among the largest made and each has eighteen studs. The smallest size has twelve. From five to seven girls are usually stationed around one of these turntables, but some were omitted here so that the work might be pictured more clearly. Fifteen girls at three tables now assemble as many chambers as 22 did before this fixture was devised.

For testing various products and for special purposes there is a demand for air at 175 pounds pressure. This is obtained by boosting some of the 125-pound air in a steam driven compressor and is distributed in the plant by a 3-inch main having perhaps 50 take-offs. The air receivers or reservoirs of the brake assembly are tested under 250 pounds pressure with air furnished by a separate motor-driven unit. In conducting experimental work on air brakes for aircraft there is need for air at 2000 pounds pressure. This is supplied by a motor-driven, air-cooled, 3-stage compressor.

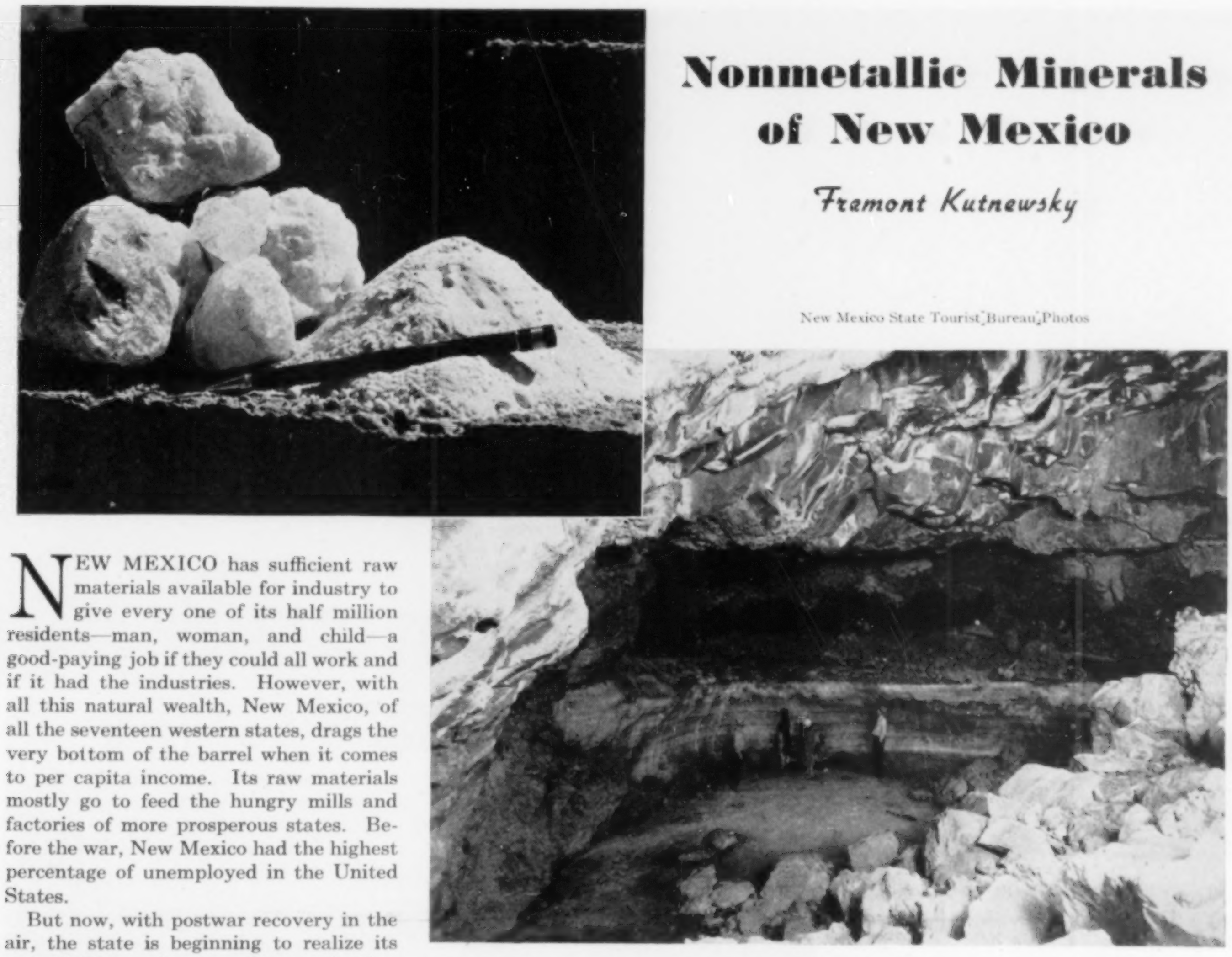
The success achieved by Bendix-Westinghouse with the brake chamber in its own operations has prompted the thought that other concerns engaged in turning out small machine parts and having manufacturing procedures and problems generally similar to those at Elyria may find it equally useful. It also seems likely that many other industries could apply the device profitably. Without having made any special effort to promote its general use, the company has already received orders from several firms. It may transpire that its experiences in improving its own plant practices will eventually lead to what might be termed an industrial business of considerable proportions.

Two examples of current applications of the chambers may be cited. A truck-trailer builder uses 24 of them to clamp structural frame members into an assembly for welding. All are controlled by one valve, whereas the C clamps formerly employed had to be tightened and loosened individually by hand. In another case, a manufacturer of a holding fixture embodies six chambers in his product.

# Nonmetallic Minerals of New Mexico

*Fremont Kutnewsky*

New Mexico State Tourist Bureau Photos



**FLUORSPAR**

Fluorspar was in great demand during the war for use in the steel industry, as a catalyst in one step of the manufacture of aviation gasoline, and in aerosol—insecticide—dispensers for the armed forces in the Pacific. New Mexico produced 10 percent of the nation's supply in 1944 and increased its output for the eighth successive year. Samples of fluorspar from near Deming are shown at the top. Near fluorspar deposits in the vicinity of Grants is a cave in which a perpetual band of ice is exposed (above). No logical explanation has been advanced for its existence in a region where temperatures are above freezing throughout most of the year.

NEW MEXICO has sufficient raw materials available for industry to give every one of its half million residents—man, woman, and child—a good-paying job if they could all work and if it had the industries. However, with all this natural wealth, New Mexico, of all the seventeen western states, drags the very bottom of the barrel when it comes to per capita income. Its raw materials mostly go to feed the hungry mills and factories of more prosperous states. Before the war, New Mexico had the highest percentage of unemployed in the United States.

But now, with postwar recovery in the air, the state is beginning to realize its potentialities. A nonprofit organization has been formed to acquaint westward-moving industries with all its natural advantages, not the least of which is a rapidly increasing population and an expanding labor force. The New Mexico Development Foundation is busy collecting evidence of conditions that are attractive to more than 60 kinds of processing and manufacturing industries and is negotiating for a dozen prospective enterprises. Many of these prospects are based upon the state's rich and varied resources in nonmetallic minerals. While the second world war brought practically no new industries to the state, it did boom mining and opened the door to vast industrial possibilities, especially in the production and the processing of nonmetallics.

When the Spaniards nosed into this part of the world some 80 years before the English arrived at Plymouth Rock there was little thought of anything but silver and gold. After our occupation in 1846, American adventurers followed the same lead. Like their Spanish predecessors, they fought the bloodthirsty Apaches for a chance to get at rich pockets of precious metals, and dug out a lot of them. Trudging over the rocky hills and sweating in their mine shafts, these treasure seekers passed up far greater wealth than they ever recovered in gold and silver.

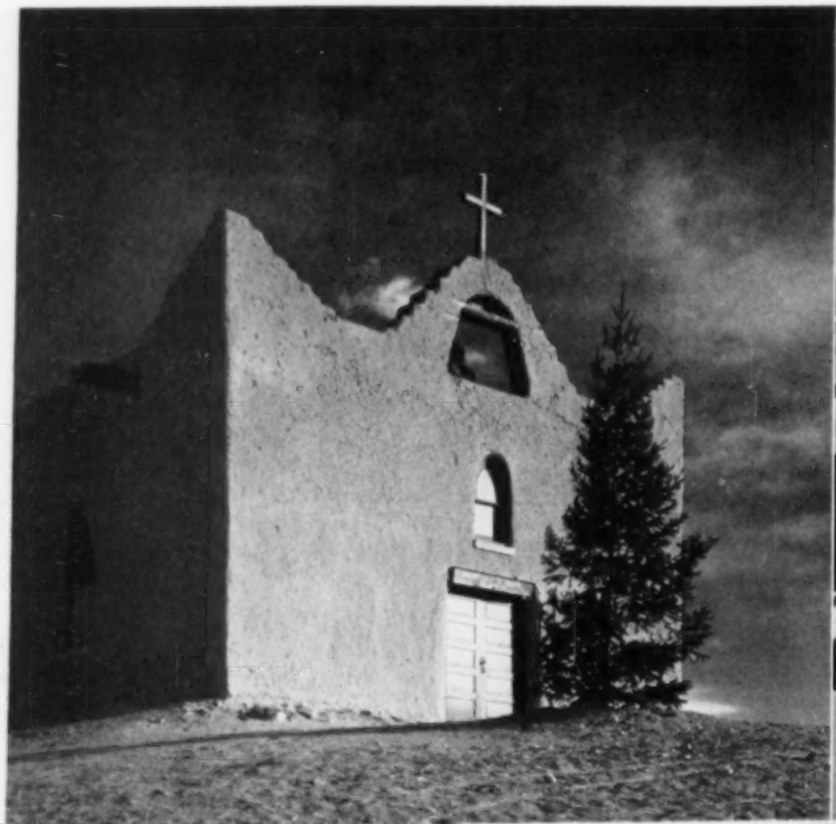
While they were cleaning up the cash crop, the Machine Age began to materialize with its ever-widening demand for the so-called baser metals such as copper, lead, and iron. Mining for these ores reached its peak during World War I. Fortunes were made, but still greater opportunities lay ahead as America turned to chemical and technological development when caught short during that conflict. Then came calls for more and more of the lesser-known, lesser-valued minerals—potash, fluorspar, pumice, lithium, silica, mica, talc, and calcite.

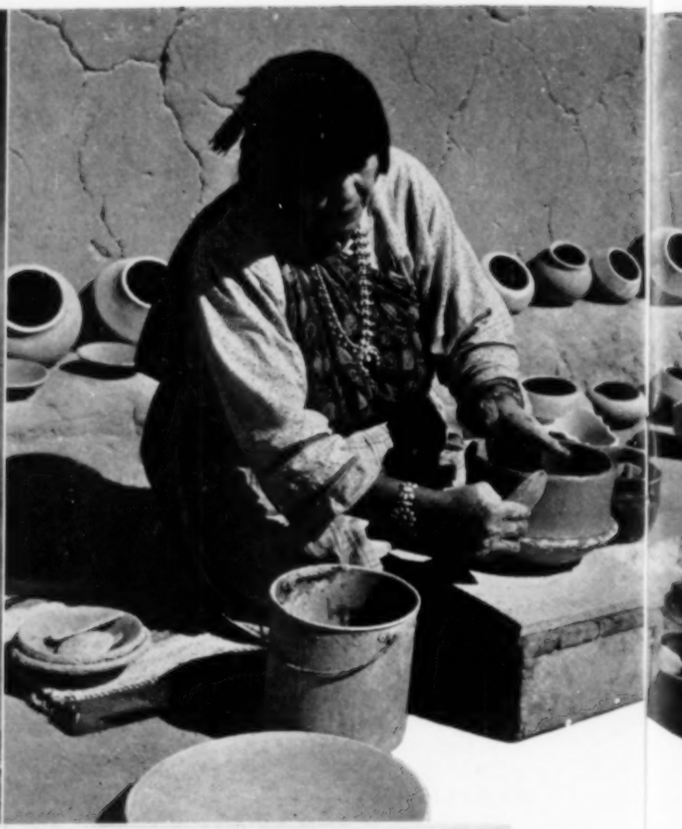
In 1943, at the height of the industrial production that enabled this country to win the second world war, New Mexico contributed nonmetallics worth $87,000,000, as compared to $37,000,000 worth of metallic ores. Silver and gold had lapsed into insignificance. Copper and zinc, important as they were, took second place, being superseded by petroleum and potash. At that time the phrase "If you can't find it anywhere else look in New Mexico" became a byword among government scouts who were prospecting for rare minerals.

The important difference between metallics and nonmetallics mined in New Mexico is that the former feed only distant mills of established industry while the latter invite new fields of industry to the state. Markets are within easy reach for many kinds of processed and fabricated products made of or calling for the use of nonmetallics, the general demand for which is on the increase. Among the minerals of this class that did a big war job were helium, carbon dioxide, fluorspar, pumice, talc, and potash, all of which are found in New Mexico. In this group should be mentioned petroleum (the state is seventh in volume of production) and natural gas. The latter have far more applications now than formerly when they served primarily as fuels and lubricants.

New Mexico's potash deposits in the Carlsbad area have once and for all freed the United States from the danger of dying soils. After teaching us how to use that mineral in fertilizers, the Germans, who apparently controlled the world supply during World War I, counted on potash starvation to cripple the American war effort—and they came close to doing it. A frantic postwar search ensued, resulting in the discovery of beds in southeastern New Mexico and western Texas that are so extensive that there was no fear of a potash shortage during the second world war—in fact, there was a surplus for export. New Mexico fluorspar deposits also came to the rescue during World War II when other sources began to dwindle. Several mills were set up, notably the one at Los Lunas operated by the Zuni Milling Company that has good prospects of competing with other producers of high-grade acid spar in meeting the country's normal requirements. War-discovered uses for fluorspar derivatives —DDT, for example—have expanded its market.

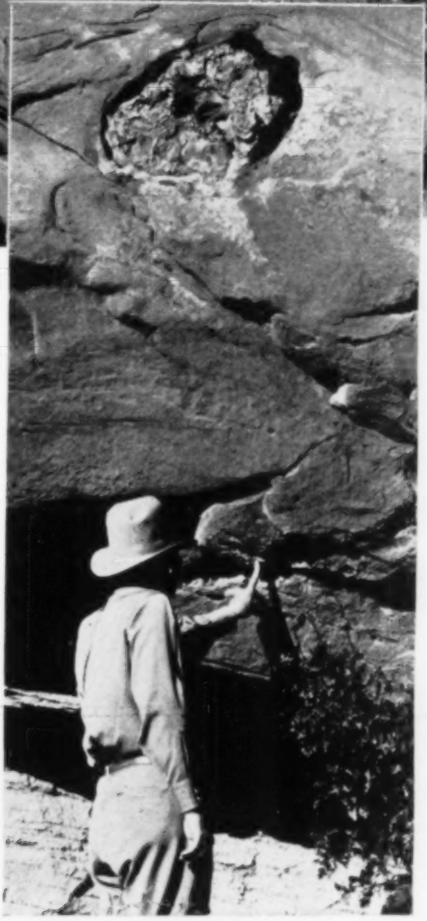
New Mexicans now foresee considerable local industry in the chemical field because of the availability of potash and fluorspar. The present output of three large potash mining companies at Carlsbad goes largely to manufacturers of commercial fertilizers, but as the salts are the basic material of many essential chemicals they are being eyed, among others, by prospective makers of insecticides. By the time this article is published, the state will have its first fertilizer plant founded on an extensive supply of lignitic shales at Gallup. Its product will be a soil conditioner that contains 24 mineral elements essential to productivity and that has been used successfully as a cure for plant diseases. It serves to supplement commercial fertilizers.





**CLAY**

Clays of many types abound in New Mexico and some of them have been used for untold years by Indian potters (top-center). Often they dig their supply of clay near their homes (above). Adobe, which is largely flood-plain clay, has long been favored as a building material by the Indians and Spanish residents. At the top-left is an adobe church near Pojuague that might pass for one of the early Franciscan missions. It has walls several feet thick.



**GEM STONES**

Ricolite, a variety of verde antique that is found only in New Mexico, outcrops in the cliffs of the Gila Canyon (above). Ricolite is used for decorative purposes as well as in jewelry. A section of a petrified tree protruding from a sandstone bluff is shown at the left. As turquoise becomes scarcer, Indian silversmiths are employing this agatelike rock more and more as settings in their distinctive jewelry.

Another important New Mexico nonmetallic is pumice, which is obtained at Grants. There is a steady peacetime demand for this ace of abrasives, which also found new applications during the war, namely, as an ingredient in nonslip deck paint and for processing high-octane gasoline. There are large deposits of pumice, pumicite, scoria, pearlite, pitchstone, and vermiculite scattered throughout the state that are being developed as a part of New Mexico's postwar industrial awakening.

Pumice and scoria (volcanic sinter) are being used extensively as aggregates in lightweight building blocks. Both, because of their glassy composition and cellular structure, have good insulating qualities against heat, cold, and sound, and they are practically fireproof. Some 50 or 60 companies in the state are engaged in their production according to varying formulas and with many kinds of aggregates, depending upon the local supply. There is more or less adobe and sand in most of these blocks which, in view of the scarcity of other building materials, have proved a boon to the construction revival going on in New Mexico, as elsewhere

Vermiculite is entering into the manufacture of a 3-in-1 plaster (sound, heat, and fire resistant) and of boiler insulation. The plant is in Albuquerque and is experimenting with a plastic roofing material containing vermiculite as the aggregate. It is applied like frosting is put on a cake and 2 or 3 inches thick. If tests prove it to be satisfactory, it may be the answer to the great need in the Southwest for roofing that will stand up under the hot sun-cool night combination that is so destructive to the materials commonly employed for the purpose. Vermiculite and pitchstone, of which there are adequate newly discovered deposits, are being considered for use in roofing tile.

Fostered by the Development Foundation, studies are being made of the possibility of manufacturing wallboard from pitchstone, which differs from pumice principally in porosity. Both are of volcanic origin and composed largely of silica. Pumice was blown out of the earth and hardened in midair while still full of steam. It is porous to the finest grain. Pitchstone hardened while static. It contains sufficient moisture to cause it to pop like popcorn when heated and expands to many times its original bulk. Properly exfoliated, it has the appearance of semirigid rock wool. Pitchstone wallboard, it is pointed out, would be termite- and verminproof. Efforts are being made to find some local vegetal substance that will combine with it to give it fibrous strength. The lowly yucca is believed to possess the necessary properties—tensile strength, pulping quality, and saponin to assist in decortication.

The building-material shortage has stimulated interest in New Mexico's large and varied beds of clays, gypsum, limestone, and cement rock. When it was discovered that, even in normal times, the state has a market for more than 450,000 barrels of cement annually, exclusive of public works, three companies announced plans to go into cement production there. Two of them have obtained sites close to the essential raw materials and fuels, either coal or natural gas. With the state's big postwar highway program and the new lightweight building-block industry the demand for cement has considerably increased.

There are extensive deposits of the purest-quality gypsum in various parts of New Mexico. Most noteworthy, perhaps, is the one in the Tularosa Basin near

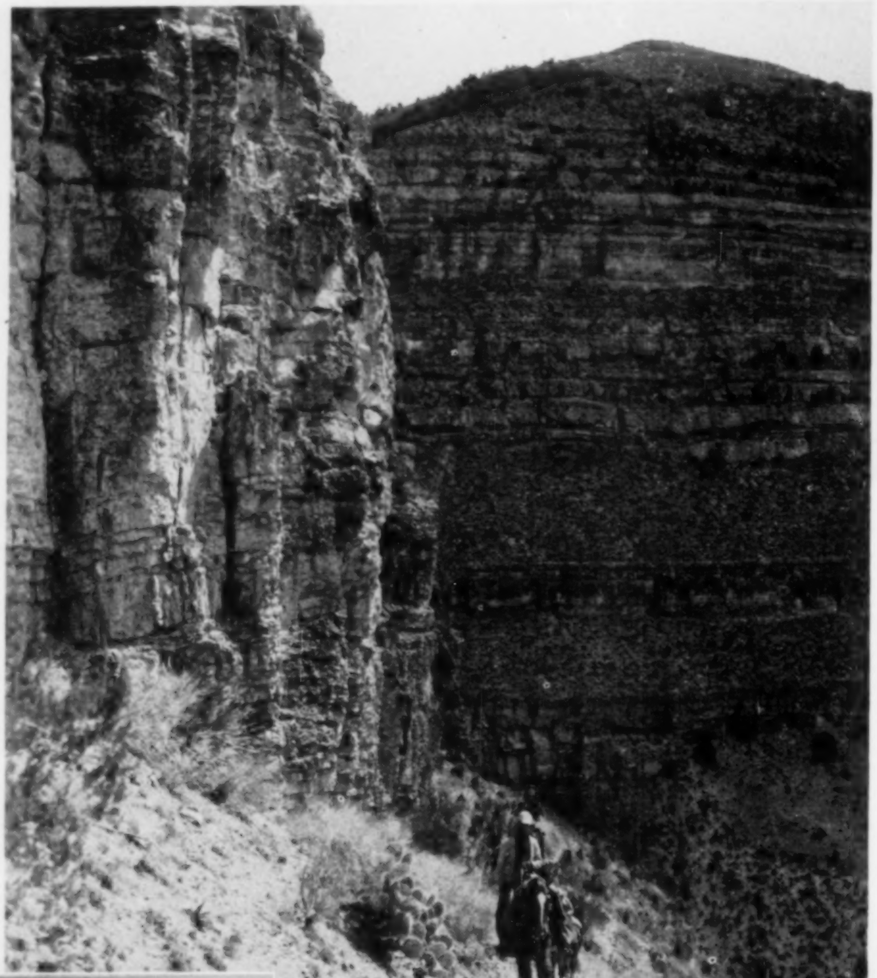
Alamogordo in the southern section of the state. There it exists in the form of a white sand that covers a wide valley floor in glittering dunes. Some of this area lies within the White Sands National Monument which is a scenic attraction for visitors. However, there is enough gypsum outside of its limits to supply all United States needs for a long, long time. It was close to this region that the world's first atomic bomb was set off, with the ensuing political and scientific reverberations.

New Mexico gypsum has been made into fine finishing tile, and is the basic material of a sizable novelty business in the vicinity. Curiously, a practice of the nearby Mescalero Apache Indians pointed to an application that may prove of far-reaching importance. It was observed that the Indians used the sand as a dry cleaner—to remove grease from their sheep pelts. A garageman tried it on his concrete floor and discovered that it not only absorbed oil and grease but, after frequent applications, also gave the floor a glaze that was resistant to oil and grease. As a sweeping compound it may prove to be a find, especially for garages and service stations. Meat-packing plants and factories where acids and oils are a fruitful source of bacteria have shown interest in the material. Gypsum for plaster and wallboard is always a good bet, and ample reserves await the enterpriser in the south around Alamogordo as well as in the northwestern part of the state.

New Mexico is rich in clays. No extensive studies of them have ever been undertaken, but they cover a wide range of qualities. The Indians of the Rio Grande Valley have been making pottery of clay for generations. Some excellent artwork, mostly for outdoor use on large estates, is being produced at La Luz near

SCENIC SETTINGS FOR NONMETALLICS

Close to the site in the Santa Fe National Forest between Santa Fe and Taos shown at the bottom-left are found mica and iceland spar, both of which were essentials of instruments used during the war. Dog Canyon, below was used as a retreat by the Apaches under Geronimo and Victorio when they were battling the U. S. Cavalry. Its sheer walls rise 2000 feet in places. It is accessible only by means of the Eyebrow Trail. Nearby, white glittering dunes of sand that cover a wide valley floor contain enough gypsum to supply the needs of the nation for a good many years. The potash mines that furnish 85 percent of our requirements are located not far from Carlsbad Caverns National Park (bottom-right).



COAL

Coal mining is a major industry in New Mexico. Investigations are now being made looking toward a coke industry that will utilize slack and produce ammonium compounds and other valuable substances as by-products.

Alamogordo; and the high school at Clayton, at the opposite end of the state, furnished its dining room with a sumptuous table service of local clay. Vocational courses in pottery making give promise of the commercial exploitation of the deposit in that section. Several artists in Albuquerque and Santa Fe have kilns for pottery baking, and find a ready market for their products. Some beds of the purest kaolin are known to exist in New Mexico, and quantities of it have been sold for use as fillers in oil cloth, paper, linoleum, etc., manufactured in other states.

A heavy blue clay from Roswell effectually stops leakage from artesian wells, which are the only sources of water for irrigation in the rich artesian basin of the Pecos Valley. Other clay in Lea County has been used for mudding oil wells in the Hobbs Field. In the vicinity of Fort Sumner, a semibentonite mixed with gypsum has been found to be excellent for lining irrigation ditches and is cheaper for that purpose than concrete. In this semiarid land it is vital that every drop of irrigating water be conserved. Adobe brick, the sun-hardened material of which the majority of New Mexico houses were constructed until the turn of the century, consists mostly of flood-plain clays. It is still a favorite building material of native New Mexicans and, because of its fine insulating qualities, is also used at times in structures of the costly type.

Bentonite, a claylike substance resulting from the devitrification and chemical alteration of glassy volcanic ash, is present in the state but has not been mined extensively. Chambers, Ariz., just across the border, is a well-known source of the material, which is much in demand for soaps and beauty clays. It has lathering and detergent properties and serves as a filler, binder, or plastic in paper. Further, it is used for refining fats and oils and enters into the manufacture of insecticides. It is a chemical agent in water softeners and an ingredient in various drugs and antiphlogistics. It is sometimes called "Denver mud." Bentonite is a perfect example of a common material for which more and more applications can be found, for there was a time when man had only two uses for it: as a soap and as a lubricant for the high-wheeled Conestoga wagons of days gone.

Since the war there is renewed interest in New Mexico in the making of fireclay. The raw material, one of excellent quality, has been mined in the Gallup area for a long time but has been sold to large smelters in the Southwest for lining furnaces. Now, an enterprise has been set up south of Gallup to manufacture fireclay products and other clay tile. The big Chino Mines copper smelter at Hurley, N. Mex., uses fireclay from a bed near Hatch, an area where there is ample water and a railroad, conditions that are favorable to the fireclay industry. Another mineral deposit at Hatch which is attracting attention is one of red oxide of iron, a valuable ingredient in paint. The state has huge reserves and a wide variety of colored earths all useful for coloring paints.

New Mexicans, especially industrial engineers, believe that it will be only a matter of time until we will see large glass works in the state. A deposit of silica, 97.7 percent pure and covering an extensive area, has recently been discovered near Tucumcari, seventeen miles from its eastern border, where an abundance of low-priced natural gas is available. The sands have not been given thorough investigation, but when the atomic-bomb explosion melted and converted them into a sort of crude glass for miles around the test site, interest was aroused in the possibility of New Mexico as a glass producer.

Efforts have latterly been made to extend a railroad line into the northwestern part of the state and on into the San Juan Basin, which lies partly in Colorado. The principal reason, beyond shipping fruit from that rich section, is to get at deposits of coking coals which are now in demand on the West Coast. New Mexico has very large reserves of different grades throughout the state. The soft coal in the area just mentioned has been found to possess a brown aniline base, which suggests the making of tannic acid. Experiments towards this end are in progress. This is significant in that more than 80 percent of the tannins now used in the United States are imported.

Coking coals near Raton in northeastern New Mexico are being studied in view of the fact that it is proposed to build a chemical plant there for the manufacture of ammonium nitrate and ammonium sulphate, benzol, toluol, xylol, nitrobenzene, aniline, naphthalene, phthalic acid, ammonium salts, nitric acid, and many medicinal products. Slack coal, for which there is hardly any local market, would be used for this purpose. The collieries at Raton and Gallup have suffered considerable loss of markets owing to the adoption of diesel engines by the Santa Fe Railway and the consumption of natural gas by the copper smelters of New Mexico and Arizona. An offer has already been made to buy large quantities of ammonium nitrate from the plant if it is erected, and this again fits into the picture of New Mexico as a source of fertilizers and other chemicals. In this connection it might be mentioned that the state has large resources of oxides of copper which could be converted into copper sulfate by leaching with 5 percent sulfuric acid and 95 percent water. The raw material could be obtained by open-pit mining.

During the war, successful attempts were made to furnish high-grade sheet mica. Colonial Mica Corporation set itself up in Santa Fe, but withdrew when the mica shortage was overcome. New Mexico looks forward to the full exploitation of its many deposits as soon as the market warrants it. In fact, it is thought to be feasible even at the present time provided proper sorting and storage facilities are installed. The demand for scrap mica may lure producers in that field to New Mexico because of the extensive supply available there largely in outcropping veins.

The case of calcite—Iceland spar—is akin to that of mica. Early during the war the need for optical calcite became acute, and a deposit in Embudo Canyon met the emergency. A prominent optical manufacturer has made the statement that it saved the Allied cause with respect to range finders and other optical instruments essential to modern warfare. Spar from the property is said to excel anything found anywhere except Iceland, its chief source; but one piece that was taken out was then claimed to be the largest and finest ever recovered. The canyon is not far from the famed artist-colonized Indian Village of Taos, once the headquarters and now the resting place of Kit Carson.

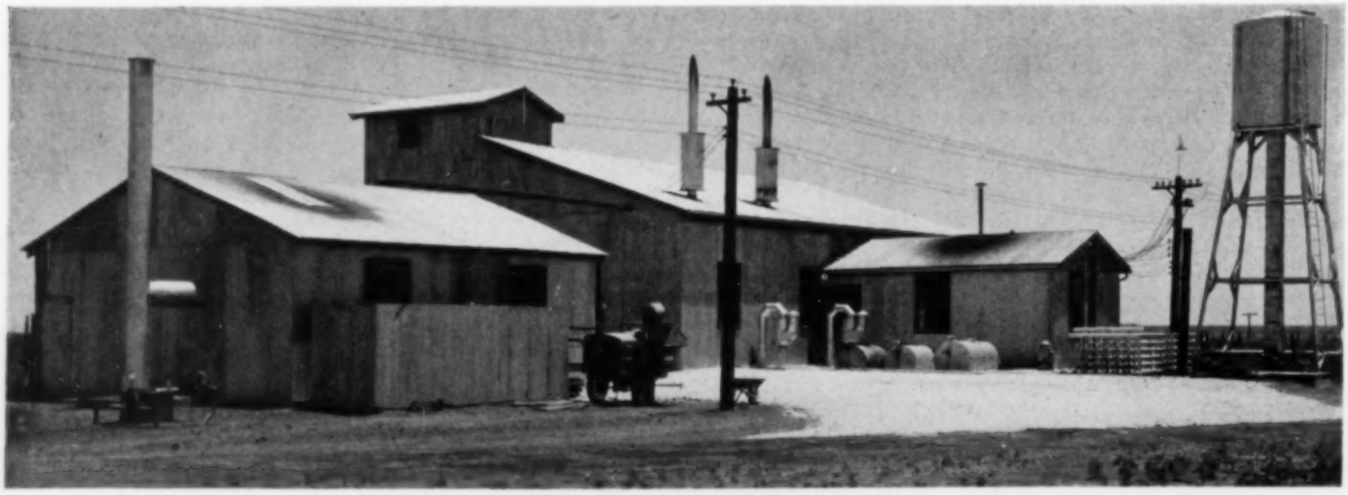
Both lithium and talc, for which new uses were found during the war, are being developed in New Mexico. A body of talc 20 miles from Rincon produced considerable tonnages in 1943 and 1944 when the mineral was a "must" in the mixing of camouflage paint for battleships. It is also of value as a slip agent in the manufacture and handling of rubber. Lithium is one of the wonder materials of World War II, for it was discovered that a little of it in glass would eliminate the glare and reflection ruinous to long-range photography. Now that reflectionless glass is here we may look forward to show windows that will make displays appear as though they were out in the open, as well as to automobile windshields that will lessen the danger of accidents through blinding light. Lithium is mined near Taos, and other sources near Rociada and Las Vegas are in process of development. Meerschaum is another rare mineral that exists in the Silver City area of the state. That produced so far contains too much quartz grit to make it suitable for smoking pipes, but the material has been ground and used for lining less expensive pipes of this kind.

Carbon dioxide, "dry ice," was obtained in its natural state from New Mexico wells some years before the war. This was a "first," because it had always been manufactured before that. No battleship is complete without carbon-dioxide fire-fighting equipment. After the dry ice is pressed into blocks it is sawed into cubes 10 inches square weighing approximately 60 pounds each. These are wrapped in specially designed double sacks of heavy paper and loaded into standard refrigerator cars. As they are well insulated, the loss in volume in transit is less than 1 percent a day. Four plants prepared 75 tons for the market daily in 1942. The principal use of solid carbon dioxide is as a refrigerant for long-distance shipments, and it is said to be from ten to fifteen times as effective as water ice. It is also in demand for quick-freezing, a field that is expanding rapidly today. In liquid form it serves variously to carbonate water and beverages, as a food preservative, and as a fire extinguisher—in fact, it is claimed to be the best oil-fire extinguisher known.

Other nonmetallics in New Mexico which have economic possibilities are graphite, zirconium, alum, sulphur, and building and gem stones. Some fine granite is being quarried near Las Vegas, and a great deal of native sandstone and limestone has been used for local structural purposes. Gem stones include turquoise, agate, petrified wood, blackwood, obsidian, and ricolite. Turquoise has long been identified with the popular southwest Indian jewelry. However, as the supply of that gem decreases the use of petrified wood mounts. And now it seems that ricolite, of which New Mexico has the only known deposit in the world, will provide the lapidary with a suitable substitute. Ricolite, a variety of verde antique, is also made into objects of art. There has been a revival of gem grinding and polishing since the war, an inviting field for anyone looking for a small, independent business.

New Mexico is being rediscovered largely because of its reserves of nonmetallic minerals. Industrialists are becoming aware of the fact that it lies in the midst of a great shipping area. Seven hundred miles from the center of the state to the east as well as to the west are regions with populations of 16,000,000 and 6,000,000, respectively. Potential enterprisers with an eye towards New Mexico are aware that 22,000,000 people represent a fine market. The states involved are Texas, Arizona, Colorado, western Kansas, Oklahoma, Utah, Wyoming, Nevada, California, Idaho, and southern Montana. The establishment of fast-hauling truck lines and the building of new highways are removing the barriers of distance that have hampered industrial growth.

New Mexico is not looking for any wonders to come to pass, but is beginning to appreciate that its raw materials will continue to find new applications as time goes on. Other significant factors in its development are the westward trend of industry in America and the increasing tendency towards production at or near the sources of basic materials. The state should also appeal to industrialists who are thinking of happy employee-relations, for people are more likely to be content in a region that appeals to them. The fact that New Mexico in normal years has attracted ten times its population in tourists and that immigration is bringing in settlers all the while, all point toward marked economic expansion.



CARBON DIOXIDE

Some of the natural-gas wells in northeastern New Mexico produce carbon dioxide that is compressed in plants such as this one to make the solid form known commercially as "dry ice." It is sawed into 10-inch cubes weighing about 60 pounds each, wrapped in insulating paper, and shipped in refrigerator cars to points of use. In liquid form it serves as a fire extinguisher, as a food preservative, and to carbonate water and beverages.

# How the Navy Salvages War Equipment

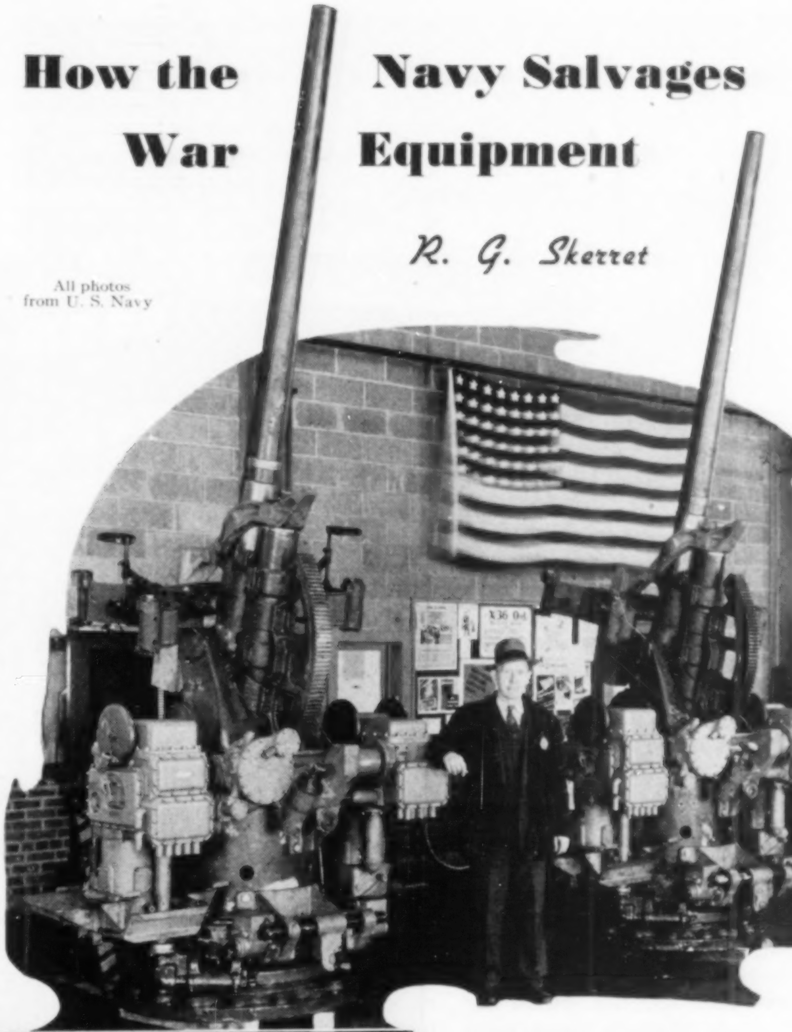
R. G. Skerret

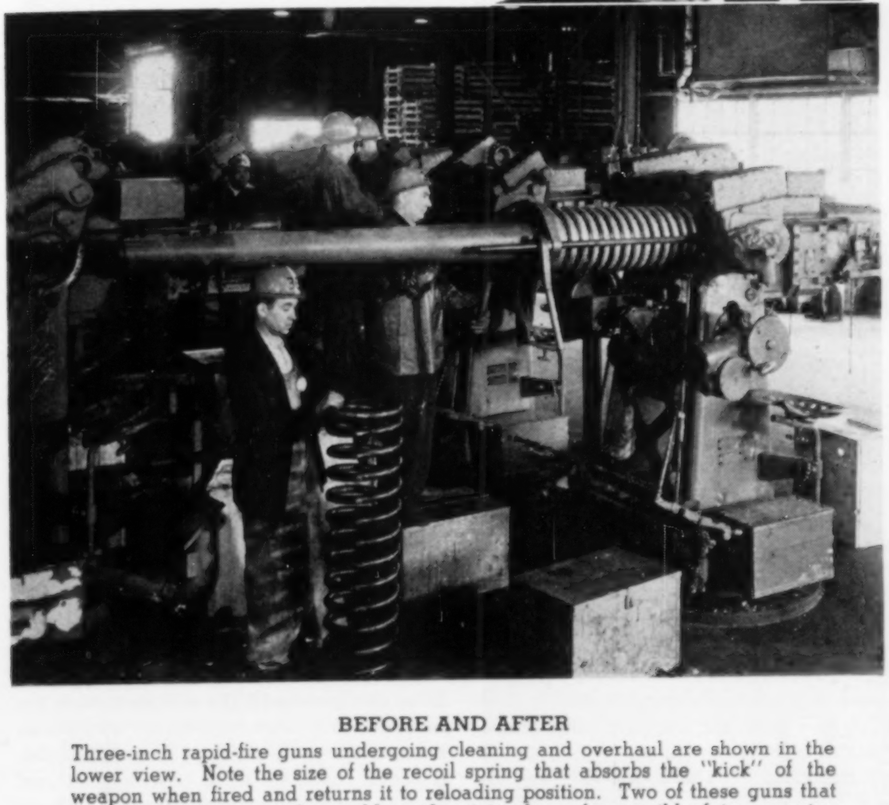
All photos from U. S. Navy

THE resourcefulness of naval technicians has converted a great wartime plant in Maspeth, Long Island, to peacetime employment and thus possibly saved it from becoming a "white elephant" on the hands of the Defense Plant Corporation. There, under the direction of the Navy, essential matériel either damaged by wear or by superficial impairment while in storage is being made fit for reuse and has already netted the national treasury many millions of dollars.

The potential white elephant, which was to produce a huge quantity of aluminum, was supplied for its electrical equipment with about 3300 tons of silver valued substantially at $66,000,000. That metal was used for making bus bars and was not exposed to fusing heat. All but 9 pounds of it was recovered after the plant was closed down in May, 1944, by which time the nation's stocks of aluminum were ample to meet all needs.

Before the Aluminum Company of America ended its activities at Maspeth, the New York Naval Shipyard in Brooklyn had become overcrowded and it was necessary to find additional space in which to carry on the mounting work of its Salvage Unit, which was handling all sorts of things classed as "battlefront backwash." With private manufacturers busy day and night and contending with manpower and material shortages or restrictions, it became evident to the Bureau of Ships of the Navy Department that pressing demands of fighting craft might be satisfied if some of the returned articles could be reconditioned for reissue instead of being broadly classified as scrap that would have to be disposed of or take up valuable space. The answer was the Salvage Unit, the money for which was authorized in July of 1943. The wisdom of that course has been substantiated by the splendid results achieved; but the public has been told little about the magnitude of the job.





BEFORE AND AFTER

Three-inch rapid-fire guns undergoing cleaning and overhaul are shown in the lower view. Note the size of the recoil spring that absorbs the "kick" of the weapon when fired and returns it to reloading position. Two of these guns that have been gone over thoroughly and put in shape for possible future service are shown at the top. They will be shipped to an inland storage point.

The wear and tear of a large fleet and the ceaseless demand for a high degree of performance do not permit of leisurely overhaul, and working parts and machinery are apt to be scrapped offhand when even moderately damaged—so much depends upon precision of action. Therefore, thousands of major and minor implements of war forming the outfittings of such craft were shipped to the naval base in Brooklyn from battlefronts and other stations connected with naval operations. The stuff arrived either packed or unpacked in widely differing stages of impairment and included guns, internal-combustion engines and their parts, radar equipment, torpedo tubes, fire-control instruments, refrigerators, pumps, potato peelers, tools of many kinds, metal helmets, electric apparatus, and what not. The aim has been to save from the scrap pile anything that could be made serv-

INCOMING MATERIAL

By railroad and barge, war equipment of every conceivable sort arrives at the salvage center from widespread theaters of war.

iceable again within permissible limits of cost and labor.

The New York Naval Shipyard has what is called the "outside machine shop"—actually within its confines—where some reconditioning is done by a labor pool made up of men awaiting assignment to a vessel that is undergoing overhaul, or has just arrived for that purpose, and others who are taking an apprentice course. This shop has reclaimed, month after month, articles to the value of $130,000 that could be delivered to the local supply officer for reissue—a striking verification of the maxim about the stitch in time that saves nine.

When the inflow of such matériel became too heavy for handling within the shipyard, then the Maspeth Annex, as it is called, was established at the erstwhile Alcoa plant and placed under the direction of Rear Admiral F. A. Daubin, USN. Its principal activities have to do with the salvage and repair of ordnance equipment and diesel-engine parts. The work started in February, 1944. Whenever possible, it has been farmed out to the original manufacturers or to qualified contractors; but by far the bulk of the reclamation has been done at Maspeth. There, in the first six months of 1945 was reclaimed ordnance and associate matériel valued at nearly $6,340,000. Weapons and parts worth $1,500,000 were distributed within the Third Naval District centering on New York City, while shipments valued at $4,000,000 went to points outside that district.

One of the difficult problems in connection with ordnance has been the matter of terminating contracts between the Government and the concerns that have helped the Navy to do its part in beating the Axis. These contracts were canceled shortly after V-J Day, and the matériel on hand had to be disposed of within set limits of time. Much of it is coming into Maspeth where it is processed and then disposed of through civilian agencies if the Navy does not need it.

The guns that have been made fit for reuse have ranged from small arms to 5-inch 38-caliber rifles. Reconditioning consists of disassembling, cleaning, replacing of worn parts, reassembling, checking, and painting—each job calling for workmanship capable of meeting the standards fixed for similar ordnance when new. In the small-arms class, 45-caliber pistols, for instance, are overhauled, refinished, and then undergo prescribed trigger-pull tests. Automatic weapons such as Thompson 45-caliber machine guns are handled by a working force of more than 50 women who are trained for the work in a small-arms school and whose deft fingers quickly take the weapons apart and put them together again.

An idea of what can be realized from such screening operations was indicated by a test made with a group of girls who were engaged in recovering small pieces of hardware. The question had been raised as to the monetary value of that salvage effort. A check-up was accordingly arranged, and it revealed that an outlay of only $119 for labor resulted in salvaged items worth $1100. Two controlling factors are taken into account before a job is authorized; namely, there must be a need for the particular instrument or part, and the cost of making it fit for reissue. If the need exists and the cost of reclamation does not exceed 50 percent of the current value of a new part or instrument then the work is approved.

Fire-control equipment has much to do with the amazing effectiveness with which naval guns are brought to bear and held upon dimly visible shifting targets while hurling salvo after salvo at them in rapid succession. Details of these apparatus are carefully guarded, but even to the casual observer it is evident that some parts are rugged while others are extremely delicate, as they must be when mechanisms are set in motion or halted by feeble electric impulses. Corresponding niceties are involved in radar equipment that also reaches Maspeth for salvage. Again, details are not available for publication, but it is of present interest that thousands of parts from these instruments are sorted, cleaned, and packed by operatives skilled in the work.

The Ordnance Salvage Center is well equipped and employs 625 men and women. At present, the most urgent job is that of dealing with the guns from the nation's armed merchant fleet. The officers and men of the "Armed Guard Units" on those vessels had to remain attached to them—could not be released from service—until the weapons were removed. As a result of pressure brought to bear on the authorities to hasten demobilization, the guns have been landed and started for Maspeth with dispatch. There they are put through the shops, the work mainly involving cleaning. This necessitates disassembling each piece to get at all the parts for degreasing, the removal of corrosion, and then reassembling it for shipping to another plant for final overhauling preparatory to placing it in permanent storage where it is held under conditions that will keep it in readiness for reissue for active service. For example, 3-inch 50-caliber guns are consigned to the Naval Ordnance Plant at Louisville, Ky., at the rate of 100 to 125 a week, while from 15 to 25 of the more formidable 5-inch 30-caliber rapid-fire rifles leave each week for the Northern Ordnance Plant at Minneapolis, Minn. In the case of 20-mm. antiaircraft guns, about 110 are dealt with daily—the work entailing reclamation as well as scrapping. Any weapons or parts of gun mounts that are declared obsolete are so effectually damaged by means of metal-cutting torches that their reuse as such is impossible.

The Ordnance Salvage Center brings to attention an interesting side light on the rapid technological advances made during the war. Stimulated by the urgency of the conflict, the inventive mind found many fighting tools lacking—tools that but a short while before were believed to be perfect and likely to remain so for a long time to come. Improvements, sometimes radical, often made such weapons obsolescent or actually obsolete. One function at Maspeth is to lessen the cost of this obsolescence by saving those working parts and fittings that are still good for use in a newer gun.

Again, the task may be one of saving most of a piece and its attachments while preparing for betterments that may make it and its class more effective. This is being done with the rapid-fire 3-inch rifles which were previously equipped with manually controlled mounts but which are being converted to power drive so that they will be more responsive in combating a fast-moving target. No doubt, the most complex of the mounts dealt with there are those for the 5-inch 38-caliber guns. The latter are fired by remote control and are intricate in their get-up. To disassemble one of these pieces, clean it, and then put it together again calls for expert handling and a high order of workmanship at nearly every step.

Only parts that are obsolete or beyond economical reconditioning are assigned to scrap piles to feed the foundries in the New York Naval Shipyard, or are otherwise disposed of by auctioning when large quantities have accumulated. The value of the operations in this section of the Maspeth Annex from January 1 to November 1, 1945, can be summed up as follows: The total moneys spent within that period amounted to $807,809, and the materials reclaimed as a result of that expenditure represented an original purchase price of $12,758,000.

Much of the cleaning of rusty or dirty parts of returned ordnance is done by putting them through successive baths of hot water, chemicals, and special solutions that prepare them for a final coat of an oily preservative. Some can be quickly freed of fouling formations by exposing them to a pneumatic blast carrying steel grit which produces a finely abraded surface that will take a lacquered or kindred finish. The same method is used to clean the large springs of the 3-inch gun mounts that absorb the "kick" of those rapid-fire weapons and return them to position for reloading.

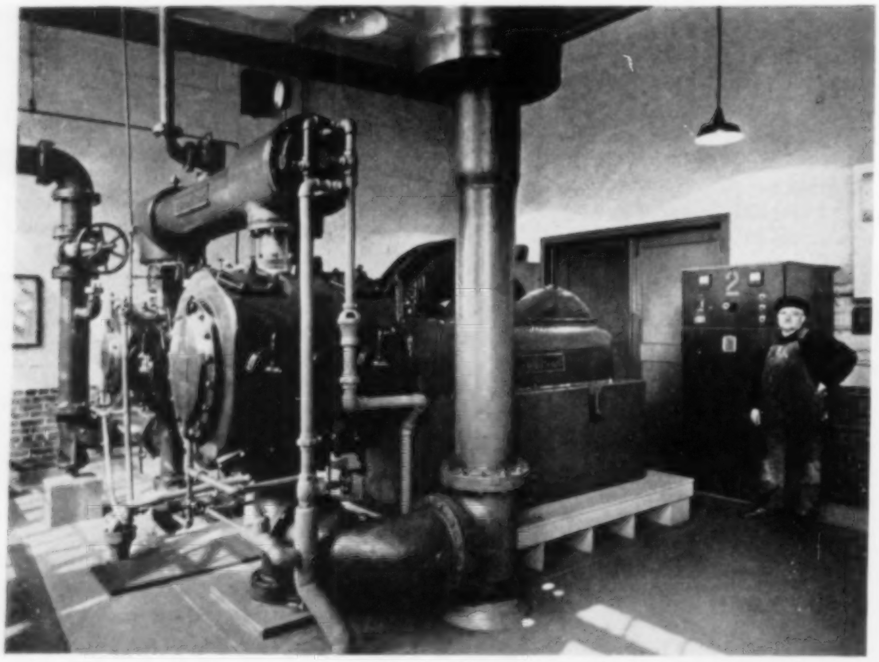
Among the mechanical refinements of the apparatus salvaged are ball bearings ranging in diameter from sizable to small assemblies not exceeding the dimensions of a dime. The races and balls are washed in kerosene to rid them of grime or hardened oil and are then blown clean and bright with forceful jets of compressed air. In fact, compressed air performs many services in the ordnance division. It is provided by two 2-stage Ingersoll-Rand Type XRE compressors each of which has a piston displacement of 1545 cfm. and is driven by a 250-hp. motor. The units are equipped with a Type M aftercooler, and each machine has a silencer-air filter. Two standard I-R air receivers are available, and these supply the lines leading into the shops and to the various points of operation.

Now we come to the Internal Combustion Engine Salvage Section. There a working force, varying from 300 to 650 as activities may require, has helped to put and maintain in operating condition engines serving either as primary or auxiliary motive units aboard vessels ranging from PT boats to the biggest of our battle wagons. During the war, when naval operations were at their climax, the plants of the country were taxed to the utmost to supply the internal-combustion engines for that force, as well as the inevitable replacements and spare parts.

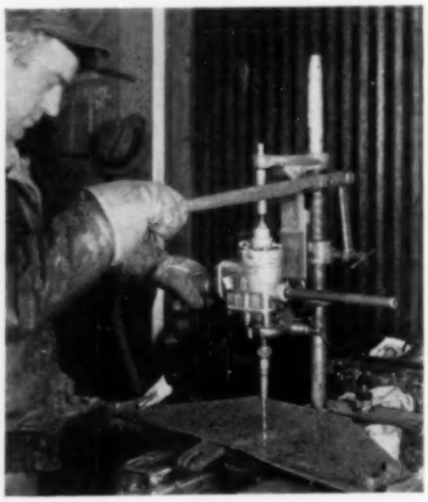
C-5
C-4
C-3
C-2
B-4
B-3
B

**PARTS AND MORE PARTS**

The entire bay illustrated at the right is given over to sorting parts of internal-combustion engines preparatory to examining them with a view to salvaging those that are worth it. The other picture shows women workers reclaiming for reuse parts from obsolete fire-control equipment of naval guns.



**COMPRESSOR AND USES OF AIR**
At the left is one of the two Type XRE compressors that furnish compressed air for varied purposes in the Ordnance Salvage Center. By means of the ingenious fixture shown below, a multi-vane pneumatic drill is made to serve as a drill press. Some internal-combustion engine parts are sprayed with a special preservative (bottom view). The tank catches the drippings.



Worn and damaged engines and engine parts from all sorts of craft sooner or later were shipped to the New York yard and, subsequently, to Maspeth Annex for handling and disposal. The work proved much more complex than might be imagined offhand, and in the case of certain obsolete parts even involved engineering changes to adapt them to current needs.

The Navy uses several hundred makes and sizes of internal-combustion engines, the structural features of which differ considerably. Returned parts may be spares that have lain in storage and become corroded; they may be damaged, but not beyond repair; or they may have concealed fractures that must be discovered so as to determine whether they should be reconditioned. But first they have to be identified, and this is apt to be difficult because the shipments often arrive in nondescript containers bearing no marks to indicate the type of engine from which the parts came.

The cavernous storerooms are piled high with boxes and crates, just as are those in the Ordnance Salvage Center. Unpacking is done in one of several big bays, and a group of trained workers has the seemingly bewildering responsibility of identifying each part and assigning its place in the set-up of an internal-combustion engine of given design and size. These workers must possess more than commonly good memories. To help them, large photostatic prints of many kinds of engine parts are arranged like a decorative frieze along the upper section of the side walls of each bay. But even that display includes but few of the drawings that have to be kept in mind or available for reference. At one side of the bays is a room equipped for the filing of microfilms, and there a force of microfilm readers projects the tiny pictures upon the focusing screens. Thousands of greatly enlarged images of internal-combustion engines and of their manifold parts can thus be made visible and are of great aid to the examiners in assorting and grouping shipments to facilitate inspection. Should the latter favor reconditioning, then work starts.

The first step is to clean away the dirt and to remove oxidation. Grime and grease can be got rid of by vapor degreasers or solvent baths—the choice depending upon the nature of the surface and the part itself. For example, take a cylinder liner shipped with a heavy coat of grease to protect it from the corrosive action of moisture. That grease can be removed by brief immersion in a vapor solvent. Next, the metal surfaces must be closely scrutinized to detect cracks or incipient fractures that are ordinarily invisible. These are revealed by a magnetic apparatus—the Magnaflux—based on the well-known action of a magnetized-iron or steel part to attract minute iron particles to any cleavage or sharp edge, the particles outlining it and becoming still more visible when exposed to the "black light" of an ultraviolet lamp.

At Maspeth, a ferromagnetic powder is dusted on the surface; the engine part is magnetized by passing through it an electric current of high amperage but low voltage; and the minute particles pile up in a tell-tale manner along the structural defect, no matter how fine. The powder is available in various colors that make the position and the scope of the hairline break more easily discernible. The surface to be examined must be clean and dry. The location and extent of a crack determines whether or not it is economically worth while to repair the part. If that is done, then the worn surfaces are built up by metal-spraying, chrome-plating, or iron-plating—the choice depending upon the nature of the part and the accessibility of the surface to be processed.

One means of getting rid of oxidation and grease from iron or steel parts is the Kolene process. It has proved to be especially effective in removing rust, hard carbon deposits, and the "varnishes" acquired by cylinder liners during operation, as well as in preparing cast-iron surfaces for resizing by iron-plating. The bath, which consists of a combination of molten catalytic salts, is raised to a temperature of 800°F. and activated electrically. The part to be treated is suspended in the solution and connected to a direct current of 6 volts but an amperage lower than that used in electroplating. Further, it is possible to reverse the current as the treatment proceeds. In the beginning, the metal part acts as the anode or the positive pole of the system, and this promotes the formation of oxidizing chemicals adjacent to the part, inducing bubbling. After a few minutes, the current is reversed and a reducing action takes place at the work. As a result, impurities on the part and any readily oxidizable matter are changed to oxides during the initial or oxidizing cycle; next, when the current is reversed, the oxides are reduced and cause the formation of minutely divided base metal that is swept away from the part by the agitated bath. In this way, iron and steel can be cleaned to a point where rinsing with water produces surfaces that are ready, when dry, to be coated either by metal-spraying or iron-plating. The Kolene process is also used at the annex to remove chromium-plating, which is occasionally found to be defective after it has been applied.

In the case of large crankshafts, metal-spraying has proved to be a satisfactory method of building up a worn surface to provide ample mass for machining and finishing to exact dimensions. Wire of the required metallic composition is fed at a mechanically controlled speed to each gun, where it passes through a fusing flame of oxyhydrogen or oxyacetylene and thence through an electric arc—the actual spraying of the molten metal being effected by compressed air to spread it over the receiving surface. Should it be that of a crankshaft, the latter is rotated at a uniform speed while being coated.

When a part can best be renovated by chromium-plating, which is usually much more resistant to wear than the parent metal, then the damaged area is immersed in a bath of chromic acid. In resizing cylinder liners, the procedure ordinarily followed is modified in that they are placed in a second bath of chromic acid and the activating current is reversed to impart to the deposited film an etched or roughened surface that becomes apparent only under a microscope or a magnifying glass of high power. After that, the depth between the ridges is reduced by a honing machine, which is halted occasionally to examine the work so as to discontinue honing when the surface still retains sufficient depressions or hollows to hold the oil that is to lessen friction between the moving parts—a virtue of chromium-plating. Following rehabilitation, cylinder liners are mounted on blocks and subjected to hydrostatic testing.

Small Utility type air hoists handle parts between cleaning baths and points where machining or other operations are performed, and compressed air is the driving energy for high-speed grinding tools and other pneumatic equipment in the Internal Combustion Engine Salvage Section. The air used there is supplied by two compressors, a small unit and a 2-stage, air-cooled machine—Ingersoll-Rand Type 40—with a piston displacement of 445 cfm. It is operated by a 75-hp. motor and furnishes air at a pressure of 100 pounds.

In the course of the fiscal year ending June 30, 1945, as many as 65,000 standard engine parts were reclaimed and sent to the Naval Supply Depot at Mechanicsburg, Pa. The total value of the material salvaged during the fiscal years 1944 and 1945 was $9,430,000, of which $9,167,000 was the showing for the fiscal year 1945 alone. The work done during that record year had a value of $1,898,000, with a steady rise from $344,000 in the first quarter to a maximum of $559,000 in the last quarter. New parts worth $3,588,000 were processed in 1945—none in 1944. The value of other kinds of matériel reclaimed was $300,000 in 1944 and $3,681,000 in 1945. Expenditures were $196,000 in 1944 and $1,772,000 in 1945, or $1,968,000 for the two years. In 1944 to 1945, the total reclamation cost was 19 percent, and this factor remained the same for the fiscal year 1945. These figures reveal how worth while and helpful has been the work done by this section of the annex.

At the highest stage of arrival at Maspeth, as many as 1700 tons of engine parts were delivered monthly, and by July, 1945, a million and a half pounds had been made ready for reuse. At first, only material from certain outside sources was received for salvage, but after the collapse of Germany the Bureau of Ships decided to make the plant a clearing house for internal-combustion-engine parts from the world over. The peak of the backwash from Europe has passed, and there is no knowing what will be returned from the various bases that were established in the Pacific. Much of the future work will have to do with equipment and engine parts that have been exposed for months in storage to the corrosive action of humid climates. These will be reprocessed to preserve them from impairment while held for long periods in places where heat and moisture prevail.

In preparing parts for storage of this kind, the Navy makes extensive use of a plastic dip that excludes all air from the metal surfaces. The protective film is firm and strong and, while it clings snugly, can be stripped off easily. Each part is covered with a thin oil-like coating after cleaning to protect it from corrosion while in the plant awaiting final coating and packing. The plastic dip is melted in electrically heated tanks; and on each part, before immersion, is pasted an identifying label that can be read through the envelope after it has solidified—which it does quickly. This prevents the loss of tags or labels in handling overseas shipments and avoids the trouble now experienced in identifying the contents of packages. Relatively small articles that are not given this treatment are securely wrapped in tough, moisture-resistant paper; and, as an added safeguard against humidity, the entire package is given a dip in melted wax.

The war has taught us many useful things that have potentially wide application in normal times, and packing procedures are among them because our future overseas trade will inevitably reach farther afield and be greater in volume than heretofore.

6
INSPECTORS OF ENGINEERING MATERIALS
CLOSE DOOR
RECORDAK

**MICROFILM READERS**

In this room, magnified images of countless parts of internal-combustion engines of many different types and sizes are projected on screens to help trained workers identify and sort them for inspection to determine whether they should be scrapped or reconditioned.

# Pressurized Airplane Cabins for Stratosphere Flights

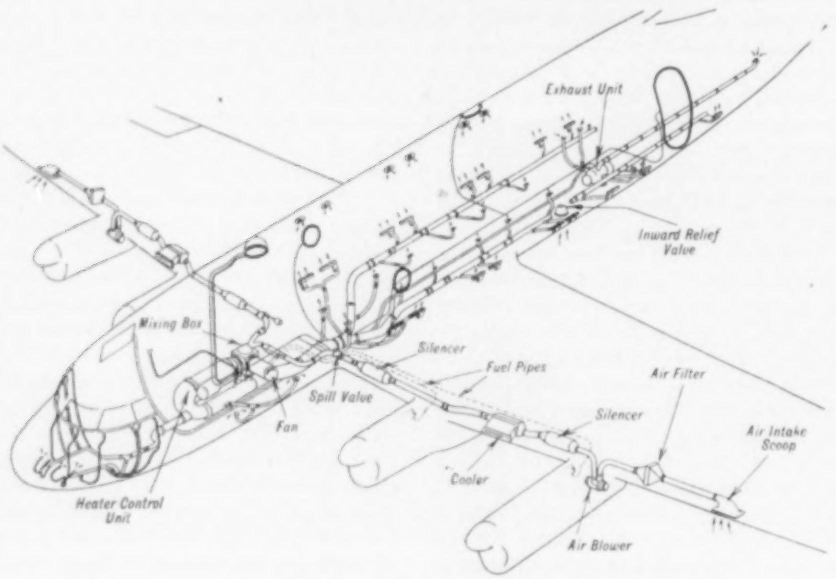


DIAGRAM OF CABIN-PRESSURIZATION EQUIPMENT

IT SEEMS certain that future, long commercial airplane hops will be made in the stratosphere, where flying conditions are most favorable. This will be especially true of transatlantic winter flights because the chances of ice formation are greatly reduced in the dry air that prevails above 20,000 feet. In preparation for this service, extensive research has been conducted in the field of cabin pressurization to mitigate the effects of altitude on passengers and crew. A report on the progress that has been made along this line by one British aircraft manufacturer was recently presented in *The Engineer*, of London, from which these facts have been extracted.

The Avro *Tudor I*, constructed by A.V. Roe & Company, Ltd., in Manchester, was designed from the outset for pressurization of all the fuselage except a small part of the tail. The plane is now being turned out on a production basis, and the first units will shortly go into commercial service. It is built and equipped to maintain atmospheric conditions of 8000 feet in the cabin when flying at a height of 25,000 feet. Test flights at altitudes greater than Mount Everest have been made, and passengers reported that they felt no discomforts. To impress upon them that bodily functions are normal under those conditions, alcoholic beverages were served by representatives of the company at a height of 25,000 feet and they had no more effect than if they had been imbibed on the ground.

The accompanying sketch shows the arrangement of the pressurization equipment, which includes apparatus for heating and ventilation. Units for humidification and refrigeration are not yet in the production stage, but they are being developed. It is the opinion that moisture will have to be added to the air during long flights at high altitudes and that the air will have to be cooled while planes are on the ground or starting off in warm climates.

Outside air is drawn in through a combined scoop and inertia filter in each wing leading edge, the intakes being located beyond the airscrew flow and away from the area that is contaminated by exhaust gases. The air passes through ducts leading to the blowers, of which there are two, one mounted on each outboard-engine accessory gearbox. On its way from a blower to the fuselage, the pressurized air is conducted through two silencers and a cooler that is interposed in the line between them. It then enters the cabin through a spill valve that embodies a nonreturn valve to insure against loss of inside pressure should one of the blowers fail.

Within the fuselage the air is fed to a recirculation-fan chamber that is heated by a surface combustion unit burning airplane fuel. The heater can be adjusted to deliver either 50,000 Btu's per hour or approximately half that output. Any desired air temperature can be obtained by jointly regulating the coolers and the heater. However, on test flights at heights of 25,000 feet and with the outside temperature at minus 88°F., the heat imparted to the air by compression alone was sufficient to maintain a comfortable temperature within the cabin. The heater is served by a separate piping system to admit and exhaust the required combustion air.

The recirculating fan pushes the pressurized air through a main duct that runs beneath the floor the full length of the cabin and from which take-offs extend to the cabin space above. In the crew spaces and toilets these terminate in mushroom-headed outlets, but the air supply for the passengers flows through the hollow tubular arms of their chairs. The air is exhausted through slots arranged around the reflectors of the ceiling lights. Some of this vitiated air is then routed to the recirculating-fan chamber and mixed with the incoming fresh air from the blowers; the remainder is discharged near the rear of the cabin through a valve that incorporates a safety valve. At 25,000 feet altitude the differential in pressure between the interior and exterior of the cabin is kept at 5½ pounds per square inch. The amount of air passing out is regulated in the flight-engineer's compartment by two aneroids that are connected with the discharge valve.

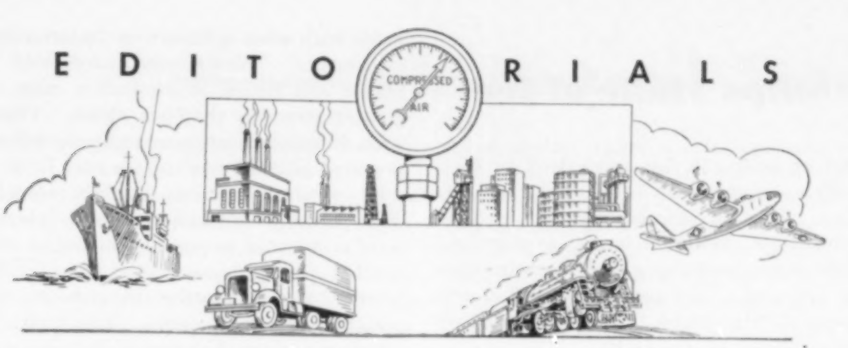
The cabin is rendered airtight during assembly by sealing all metal-to-metal joints with a compound that is either brushed or sprayed on. All control rods and cables that go through the fuselage are fitted with pressure seals at their points of emergence. The entrance door, cabin windows, and astrodome are made tight with inflatable rubber-tubing inserts, and the nose cap with a solid rubber insert. Extensive preliminary investigations were carried on to develop a fuselage structure that would be sufficiently airtight under all conditions and that would also withstand the pressure differential. To make sure of this, the cabin was designed to stand up under a differential of 11 pounds per square inch, or twice that at an altitude of 25,000 feet.

## Record Water Wheel Drives Compressor

WHAT is claimed to be the largest Pelton type of water wheel in existence operates a compressor that furnishes air to the Morning Mine in the Coeur d'Alene District of Idaho. The wheel is 104 feet in circumference. The water that drives it falls 1200 feet and is directed through six nozzles at a pressure of 520 pounds per square inch. The buckets on the wheel travel at the rate of 94½ miles an hour.

The large wheel is aided by two 12-foot ones operated by water that has a drop of 110 feet, and the compressor delivers 5200 cubic feet of air per minute. The air is piped 6 miles to the mine where it is used. The plant was built in 1900 by Larson & Greenough, who then owned the Morning Mine, and has been in continuous service ever since. In periods of low-water flow when its output falls below requirements the difference is made up by two electric-driven compressors housed in the same building.

# EDITORIALS



## POWER-TRANSMISSION TESTS

TWO experimental electric transmission lines that will materially influence the trend of power transmission are being erected at a fuel-burning generating station in Ohio. They are only 1½ miles long, but they will suffice to answer a lot of questions that are now in the minds of electrical engineers. Current will be carried over them at voltages up to 500,000 to permit making studies of all the functional and financial aspects involved. The aim is to ascertain whether it will be feasible and economical to adopt higher voltage systems to distribute the larger blocks of electrical energy that will be needed to meet the growing demands.

Higher voltages enable lines to transmit power longer distances than low voltages, but the cost of the larger-capacity equipment required is greater. The projected experiments will seek to determine optimum voltages and lengths of line. The information will be useful regardless of whether the energy comes from conventional stations or from the atomic-power plants that the future may bring forth. The lowest-cost power now obtainable is that from fuel-burning generating stations situated close to the areas of consumption, and it is to be used as the standard of value for comparison. Such a plant, when operating at half its rated capacity, can produce electricity at around 0.5 or 0.6 cents per kilowatt-hour. At the voltages now employed, that energy can be carried for around 0.1 cent per 100 miles. In other words, it costs about as much to transmit it 500 miles as it does to generate it.

Fortunately, fuel-burning stations can be located near load centers, so the economics of transmission is less important in their case than in that of hydroelectric plants that have to be built where waterpower is available. Hydro stations can be operated at lower cost than fuel-burning plants, but their first cost is higher. And if the power has to be carried long distances, the over-all cost to the consumer may be greater than it would be if a fuel-burning station were set up nearby, even allowing for the possible expense of having to ship in fuel. Higher voltages may equalize some of these differences, and may also permit the interconnection of power plants throughout a greater area.

The highest-voltage transmission line now in commercial operation is the 287,000-volt system extending from Boulder Dam to the Pacific Coast. Until it was placed in service the record was 220,000 volts. Engineers are now talking about voltages up to 400,000, and the tests soon to be conducted in Ohio will largely determine whether or not they are to be adopted. The experimental lines are being set up through the joint efforts of The American Gas & Electric Corporation and nine manufacturers of transmission equipment.

## BETTER BUILDING CODES

ANY fair-minded person will agree with the idea that laws and regulations should be revised from time to time if they are to keep pace with continually changing conditions in the fields to which they pertain. A simple example is the necessity, which has arisen in our generation, of amending the traffic laws to make them applicable to the automobile age. Oftentimes, however, the changes in regulations lag behind progress. This is true of our building codes. Some of the provisions that are now in force in different localities were written during the horse-and-buggy era of construction and need to be brought up to date.

This situation has long been recognized by interested individuals and groups, and considerable headway has been made in correcting it. Nevertheless, many codes are still inadequate in the light of modern conditions and are definitely impeding construction and adding to its expense at a time when we can ill afford to have such brakes applied. In an effort to clear away the obstructions, the Construction Division of the Department of Commerce and the Bureau of Standards are taking the lead in a movement to bring about modernization and standardization of building codes throughout the nation.

This is being done by studying the codes of representative municipalities and comparing their provisions with a comprehensive list of generally acceptable standards. Special attention is being given to ferreting out requirements that restrict building or add to its cost. Where these are found to exist, they will be pointed out for the guidance of the regulatory bodies that have the power to change them.

Building codes were originally designed to insure structures that would adequately protect life and health and contain reasonable safeguards against fire and collapse. During the reign of King Hammurabi of Babylon from 2067 to 2025 B.C., an edict was issued that put the responsibility on the builder, who was both architect and artisan. Its provisions were drastic, but undoubtedly effective. If a house collapsed and caused the death of the owner, the builder was put to death. If a son of the owner was killed, then a son of the builder had to die. If a slave of the owner lost his life, the builder had to replace him with one of his own slaves. Furthermore, if it was proved that a house collapsed because it had not been firmly constructed, it had to be rebuilt at the builder's expense.

During the intervening 40 centuries, emphasis has properly been placed on soundness and safety. Until a few decades ago, building materials and construction practices remained pretty much as they had been for ages, and there was little need for code revision. In recent times, however, the development of new materials and techniques have made some provisions obsolete. While some municipalities have taken account of these changes, others have not. As a consequence, building codes vary widely. These differences are so pronounced as to cause one engineer who examined several codes to remark: "I never knew before that 2 plus 2 equals 5 in one city, 8 in another, and only 1½ in another; that people weigh more in Detroit than they do in New York; that it takes more inches to get people out of theaters in Chicago than in other cities; and that fires burn more vehemently in Kansas City than they do in St. Louis."

There are two general classes of building codes—the specification and the performance. The specification type may say, for instance, that a brick wall shall be at least 12 inches thick; and, as a fire-protective measure, it may call for permissible materials of certain minimum thicknesses. The performance or functional code, on the other hand, may direct that all parts of structures be designed to support safely their own weight plus all other loads imposed upon them. As regards fire protection, it will no doubt require a type of construction that will withstand a fire test of so many hours.

The specification type now predominates, although the current trend is towards its abandonment. Those who have given most study to the subject believe that a combination of the two is to be preferred. However, the main objective is not to determine the best form of code but, rather, to write one that will contain adequate safeguards without putting obstacles in the way of the builder and unnecessarily adding to the owner's cost burden. Untold thousands will give their blessing to this worthy effort.

# Ships Made of Ice

IT IS now revealed that at one stage in the war the Allied governments were actively pursuing the novel idea of constructing floating airplane bases of ice. As they were to be equipped with diesel-engine plants that would propel them at a speed of around 7 knots they could be classed as aircraft carriers. The idea was suggested by Geoffrey Pike, director of Programmes at the Combined Operations Headquarters in London. As a former war correspondent, he had studied Arctic warfare. Beginning in 1942, extensive investigations of the proposed ice ships were conducted, and they actually might have been built and used as an aid to the invasion of Europe had not events taken a turn whereby Great Britain could serve as a base.

As described in *The Engineer* of London, each "iceberg aircraft carrier" was to have been 2000 feet long, 300 feet wide, and at least 150 feet from deck to keel, with a displacement of around 2,000,000 tons. Fuel-oil storage capacity of 5000 tons would have given it a range of around 7000 miles, based on a daily consumption of 120 tons. The project bore the code name of "Habbakuk." Winston Churchill encouraged the research.

In approaching the problem, it was realized that ice lacked the necessary inherent structural characteristics, and the studies consequently took the line of seeking some means of reinforcing, much as concrete is strengthened to meet certain requirements. After beams of ice up to 40 feet long and with various reinforcing had been proved unsatisfactory, tests were made with what is known as "micro-reinforcement." Water was mixed with a binder and frozen to produce a mass of greater strength than ice alone. Trials with different substances and proportions revealed that 86 percent ice and 14 percent wood pulp gave the best results. This material formed a tough, plastic solid that could be worked like wood and showed a compressive strength of 1100 pounds and a tensile strength of 700 pounds per square inch. The mixture, which was given the name of Pykrete, was difficult to make even under Arctic conditions. The wood and water had to be mixed into a pulp, rolled on a flat surface to a uniform thickness of ⅜ inch, and then frozen with a cold air blast.

The design called for combining sheets of this material into a laminated structure of blocks 40 feet thick, and it was computed that 1,700,000 tons would be required for one floating base. Tests of the Pykrete showed that it was highly resistant to shock such as is produced by modern weapons, its bomb-resisting quality being 40 percent of that of the best reinforced concrete. It was also found that the rate of melting was materially slowed down because an insulating layer of wood pulp adhered to the surface long after the ice encasing it had melted, thus delaying seepage of the surrounding warm water to the ice in the interior. Nevertheless, an exterior insulating skin was contemplated, with pipes behind it for the circulation of brine from a large-capacity refrigerating plant. With these precautions, it was believed that an ice carrier could operate for a long time in temperate zones and even in the Gulf Stream.

To determine what effect heavy weather might have on such a structure, investigations were conducted in the Froude Tank of the National Physical Laboratory and it was decided that the only safe course would be to make it resistant to waves 1000 feet long and 50 feet high. It was revealed that these specifications could be met only by building the floating base in the form of a hollow girder, with keel and sides 50 feet thick and with transverse bulkheads or subdivisions. It was planned to utilize some of the space below deck for hangars, machinery, workshops, stores, and living accommodations for the crew. A vessel large enough to serve 200 Spitfire fighters or 100 Mosquito bombers was expected to have a complement of 374 officers and more than 3200 petty officers and men.

One of the problems in connection with the project was suitable construction sites, the requirements being intense cold, a clear depth of 150 feet of water close inshore, and proximity to a pulp mill. In the end, Canada offered the only suitable places, namely, Corner Brook, Newfoundland, and Seven Islands Bay, Quebec. Much of the experimental work was carried on at Lake Louise in the Canadian Rockies.

## Air-Space Windows for Many Services

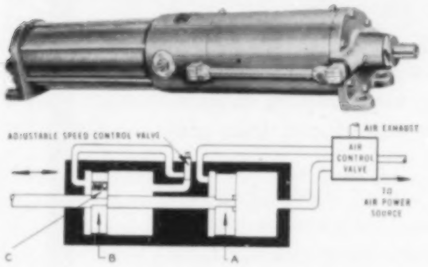
WINDOWS having two panes of glass with an air space between were introduced ten years ago for use in air-conditioned railroad cars. Under the name Twindow, the Pittsburgh Plate Glass Company is now offering similar ones for industrial, home, business, commercial, and special applications. They consist of two or more plates of glass ¼ or ½ inch apart between which air is hermetically sealed. They are suitable for stores because the insulating property of the air does not permit the transfer of cold temperatures from the outside and thus prevents the formation of frost on the inner glass surface. This feature also makes it possible to install larger than normal windows in offices and homes and at the same time reduces heating and air-conditioning costs. Clear polished plate glass is used in the case of standard units, and special glasses where they serve a purpose. In airport towers, for instance, where the direct rays of the sun constitute a problem, heat-absorbing glass is specified. Water-white plate glass which permits of true color definition with maximum clarity of vision is available for the multiple glazing of test chambers designed for low temperatures and high and low pressures.

FLOATING ON AIR

Features that were developed in the manufacture of life rafts for Allied airmen are embodied in this Goodyear inflatable boat for sports and pleasure use. It is made of rubber-coated nylon, the hull consisting of two separate air chambers of which the upper one is offset to provide more internal space. It has an inflatable rubber floor that is rigid enough to permit propulsion by an outboard motor. Although it will accommodate four persons, the craft weighs only 45 pounds with motor mount, hand pump, repair kit, sectional floating oars, and carrying case.

# Industrial Notes

Fast-acting air operation and accurate hydraulic control are combined, it is claimed, in the new double-acting Air-Draulic cylinder recently announced by the Logansport Machine Company. As the accompanying sketch shows, it features two separate cylinders assembled as a unit on a common piston rod. As the latter is moved by admitting compressed air to the pneumatic cylinder through the medium of a 4-way valve, oil is caused to flow between the chambers of the hydraulic cylinder. Built in the circuit which connects these chambers is an adjustable speed-control valve which regulates the flow of oil and, therefore, the movement of the piston rod. No hydraulic power unit is required. Cylinders come in four standard sizes from 3- to 8-inch bore and with any length of stroke up to 5 feet. Five standard types of mountings are available—foot, clevis, center-line, blind-end flange, and rod-end flange.

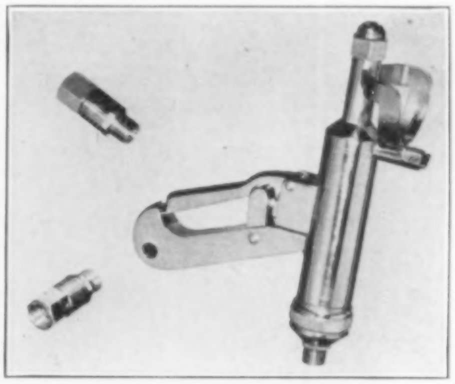


AIR POWER—OIL CONTROL

At the right in the conventionalized diagram of the Air-Draulic cylinder is the air-operating circuit; at the left the hydraulic regulating circuit. *A*, air piston designed to function at a maximum pressure of 150 pounds per square inch; *B*, hydraulic piston; *C*, ball check valve which permits free return in either direction. Cylinder is also built for controlled feed in both directions and for skip-feed movement. The unit shown at the top is of the foot-operated type.

Once in a while something new appears on the market and one wonders why it has not been thought of before because it is such an obviously simple and useful thing. Of that order would seem to be the folding steps for trucking vehicles recently announced by the Safety Step Company. There are different models designed for flat racks, stake bodies, vans, trailers, as well as semitrailers, and for side, back, and tight-spot mounting. Sturdily built of metal with two slipproof steps, each unit is fastened beneath the truck bed and will support a weight of 1000 pounds. Operation of a trip causes it to swing down and lock, while a slight lift and push on the bottom step folds it back out of the way and locks it. Installation requires no body alterations. Goes by the name of Saf-T-Steps.

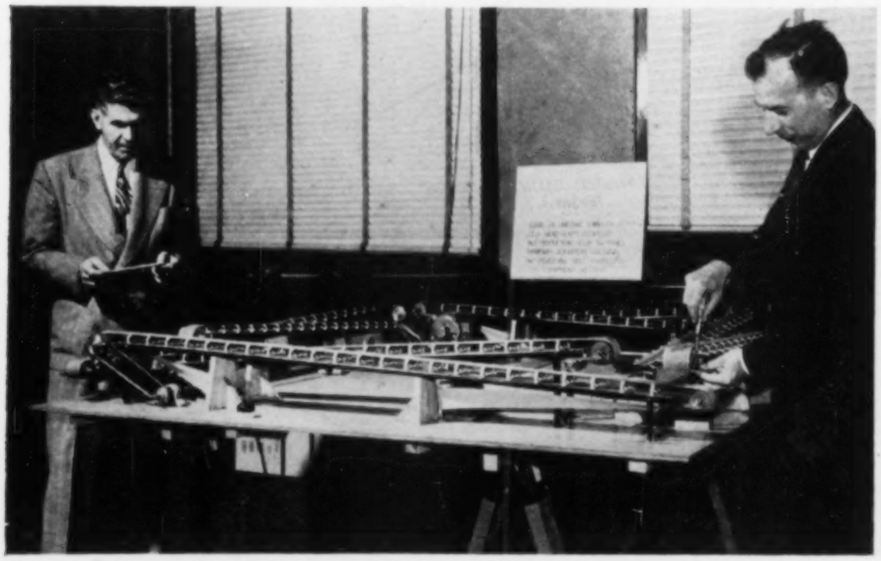
Accessory welding equipment for underwater work developed primarily for the U. S. Navy by the JO Manufacturing Company is now available for industrial use. It consists of a torch lighter and of flashback arresters that are said to have been of material assistance in the salvage and repair of government ships. The former permits a diver to light and relight his welding torch while submerged at varying depths, and the latter, which are interposed between the torch and the fuel and oxygen lines, automatically cut off the supply when the torch is disconnected and protect the hose and regulator against flashback and bursting. The lighter works pneumatically—without electrical connections, and is designed for pressures ranging from 30 to 120 pounds. It is attached to an air line and provided with a heavy pistol grip and a horseshoe-shaped bar to guide the torch into lighting position. When properly placed, the diver squeezes the grip, thus releasing air at sufficient pressure to form a protective envelope around the torch just as a strong spark shoots out and ignites it.



SUBMARINE-WELDING AIDS

Picture shows the Diamond S flashback arresters (left) and the underwater-torch lighter. The U-shaped bar at the top-right of the latter is mounted on the nozzle and helps the diver to position the welding torch at depths where visibility is poor.

Like the fabled phoenix, cities laid waste by bombs and fire during the recent war are to rise out of their own ashes. A German physicist and engineer is reported to have developed equipment for making high-strength, interlocking blocks from rubble, thus solving at one stroke the serious problems of disposal and housing in places such as Hamburg, Cologne, and Berlin. In our own country we have been manufacturing building material for some time by standardized portable machines, and these are already playing a vital part in the reconstruction of devastated areas in Europe. The various units can be strung together much like a train and moved individually from one site to another. Conversion from the raw to the finished product is a continuous one, the rubble—brick, mortar, stone, and concrete—entering a crusher at one end and emerging from a molding machine at the other. The intermediate steps consist of

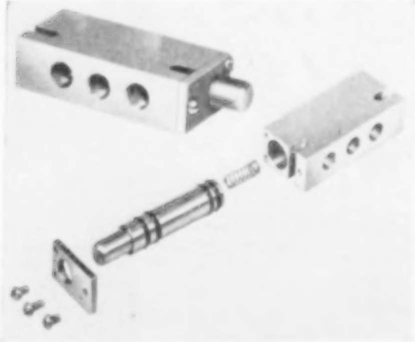


TWO-WAY CONVEYOR BELT

Four miniature conveyors with their belts arranged so that each can carry a load in two directions. Conveyors of this type will have their chief application in steel plants where ore can be hauled in and slag taken out on the "return run." These models were made by The Goodyear Tire & Rubber Company for exhibition at a recent conference of its Mechanical Goods Division in Akron, Ohio. C. F. Smith, the designer, is shown at the left. P. D. Suloff, another Goodyear employee, is adjusting the conveyor system at a transfer point.

classifying the aggregate by passing it through screens of different mesh; loading measured proportions of each grade, cement, and water into a concrete mixer; and feeding the batch to vibrating molding machines where it is compressed into blocks, roofing tile, or other building materials that are ready for use after curing.

The Modernair CRV pneumatic pilot valve recently announced by Modern Products, Ltd., is designed for either 3-way or 2-way application in normally open or closed position and for hand, foot, or cam control. Because of its adaptability, it is suitable for the operation of air controls, valves, and single-acting pneumatic cylinders such as are used to actuate vises, collet closures, and holding jigs. It is also adapted for service where time-sequence control over air motors is required and where the first unit in the sequence is operated manually or automatically. Aircraft-type packing as bearing points on the piston rod eliminates metal-to-metal contact and permits "renewal" of the valve by the replacement of four packing rings. Plunger is secured by an end plate that can be removed without breaking air connections and cannot come out of the housing during valve installation or operation. The Modernair CRV is said to be fully balanced and to operate freely and easily under conditions of extreme pressure variation.



**PNEUMATIC PILOT VALVE**

Unit is designed for 3- or 2-way operation and is shown assembled (top) and disassembled.

Phenolex is the trade name of a new aluminum paint suitable for metal, wood, masonry, wallboard, tile, etc. Applied either by brush or air spray, it is said to provide a flexible coating that is nontoxic and will not contaminate foodstuffs. It is shipped in double-compartment containers, one carrying the aluminum in powder form and the other the mixing vehicle.

To protect steel and galvanized products against corrosion in the interval between cleaning and painting, Hagan Corporation is offering a powder called Banox which, when dissolved in water,

## Niagara Aero After Cooler Protects Air Processes from Moisture Damage

Industries requiring dry compressed air need the Niagara Aero After Cooler. It provides cleaner, drier air for pneumatic tools, spray guns, sand and shot blast equipment, air cleaning nozzles and situations where air is introduced into materials in process.

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Write for Niagara Bulletins 96 and 98 for further information. Protection of air tools from moisture damages and saving in repairs makes the Niagara Aero After Cooler worth investigating.

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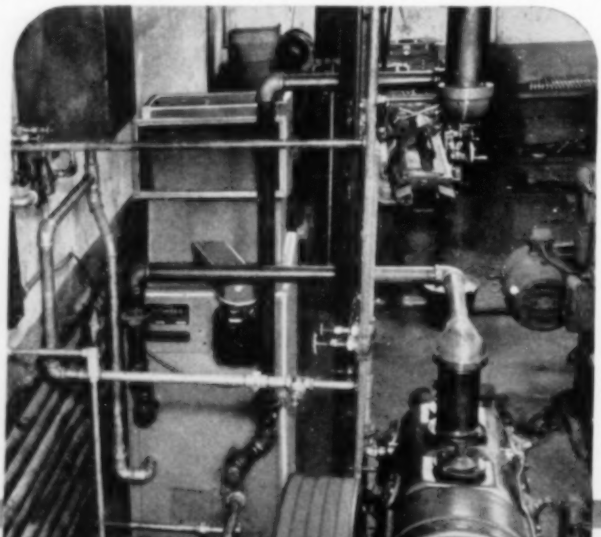

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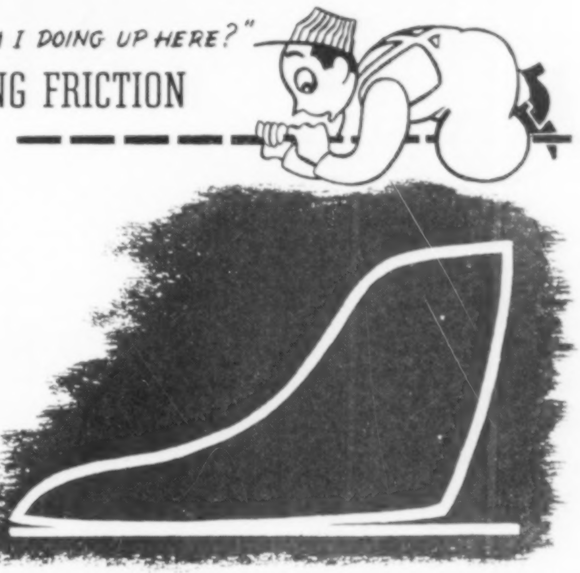
forms a flexible phosphate coating. A 1 to 2 percent solution as thin as 0.000005 inch is said to be effective, and serves at the same time as a base for the paint or lacquer, thus supplementing the anti-corrosive action of the finish.

Small permanent magnets varying in design from rings and disks to intricate shapes are being produced by the General Electric Company from five different war-born materials named cunico, cunife, vectolite, alnico 12, and silmanal. They are made of wire, strip, or rod stock and have many industrial applications, especially in the manufacture of airplane instruments.

Designed to span the gap between a plant conveyor and a truck or railway car, the new telescoping belt unit of the Standard Conveyor Company permits loading and unloading without rehandling freight. The portable section is 28 feet 4 inches long, has an over-all width of 19 inches, and can be extended 18 feet. The stationary conveyor is attached to this wheeled frame, thus providing a continuous receiving or discharging system. The belt itself is 14 inches wide. On its return run it moves over rollers in the retractable section, but when loaded it rides a second set of rollers except for a short distance when it travels over the driving pulley in the frame, which also supports the motor. The top of the pulley brings the belt in line with the plant conveyor. Carrying capacity of the portable unit is 20 pounds per foot.

Wartime experiments carried on by the General Electric Company under contract with the Office of Scientific Research and Development for the purpose of providing a suitable solder for the construction of vacuum tubes have resulted in an alloy composed of 37½ percent gold and 62½ percent copper. The material has been used effectually in making as many as twenty different types of joints that have been found to be proof against leakage and mechanical failure in service. Among other metals, copper has been soldered to steel, copper to fernico, and copper to copper. Diffusion seals between pure copper parts have been made with 0.03 inch gaskets of the new alloy and are said to be stronger mechanically than similar ones of pure gold. The melting point of the gold-copper solder ranges from 950 to 990°C. (1742-1814°F.), and this is of advantage when fernico is soldered to copper and then sealed to glass because the joint may become quite hot during the sealing process. Detailed information about the alloy and its applications are contained in a report (PB-15151) which is obtainable in photostat form, $1, or microfilm, 50 cents, from the Office of the Publication Board, Department of Commerce, Washington 25, D. C.

VARIABLE RING PRESSURE IS THE *Secret* that eliminates the Eternal Drag of soft packing friction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## Industrial Literature

A new booklet issued by Hercules Powder Company, Wilmington, Del., lists its chemicals and industrial explosives and indexes them according to the more than 50 industries that use them. The products are arranged in groups, and the salient features of each are given. The booklet is called *Hercules Products*.

A 28-page, pocket-size booklet describing the complete line of industrial rubber products made by The B. F. Goodrich Company, Akron, Ohio, is obtainable upon request. All types of hose and hose couplings, conveyor and transmission belting, adhesives, lining materials for various purposes, and industrial clothing are among the items listed.

A new catalogue describing air-control valves is offered by Valvair Corporation, 454 Morgan Avenue, Akron 11, Ohio. These valves are of the 2-, 3-, or 4-way type, and are designed to function by any one of numerous methods. Standard valves operate on air pressures up to 200 pounds and temperatures up to 120°F.

Bulletin 144 of the Shenango-Penn Mold Company, of Dover, Ohio, describes the firm's line of castings of plain and alloyed irons, with emphasis on those produced by the centrifugal method. Among the advantages claimed for centrifugal as against static castings are greater density without sand inclusions or blowholes, an increase of 2 to 3 points in Brinell hardness, 8 to 20 percent greater tensile strength, and less allowance of surplus metal for finishing.

Standard metal-cleaning and drying apparatus made by the Optimus Equipment Company, 153 Church Street, Matawan, N. J., is described in the company's bulletin 6E1. Seven basic types of machines are used for numerous washing, rinsing, and drying operations in connection with the handling of small parts. Some of the units are portable, and all are adaptable for the delivery of work to them by belts, racks, or baskets.

The Universal Drafting Machine Company, Cleveland 14, Ohio, announces a redesigned drafting machine under the name of Universal Boardmaster. It is said to be suitable for use on all types of drawing tables and to embody numerous improvements and refinements that were developed during the war. An 8-page descriptive bulletin is available.

Tests show that silicone varnishes used for the insulation of electrical machines provide greater heat and moisture resistance than the varnishes previously available for the purpose. Until recently, however, these superior properties were not always obtainable because of the high temperatures required to bake the varnishes. This difficulty has been overcome, it is reported, by a new silicone varnish produced by the Dow Corning Corporation, Midland, Mich., and designated as DC 996. Information concerning it is contained in a pamphlet titled *How to Use DC* 996.

Air cylinders are used in countless industrial services where a controlled push or pull operation is needed. They act either directly or through a lever or toggle. Hanna Engineering Works, 1765 Elston Avenue, Chicago 22, Ill., manufactures standard cylinders in diameters of from 1½ to 20 inches and with strokes as specified. They are designed to operate with air up to 110 pounds pressure and can be modified to use pressures up to 250 pounds. The complete line of Hanna cylinders is described in Catalogue No. 234.

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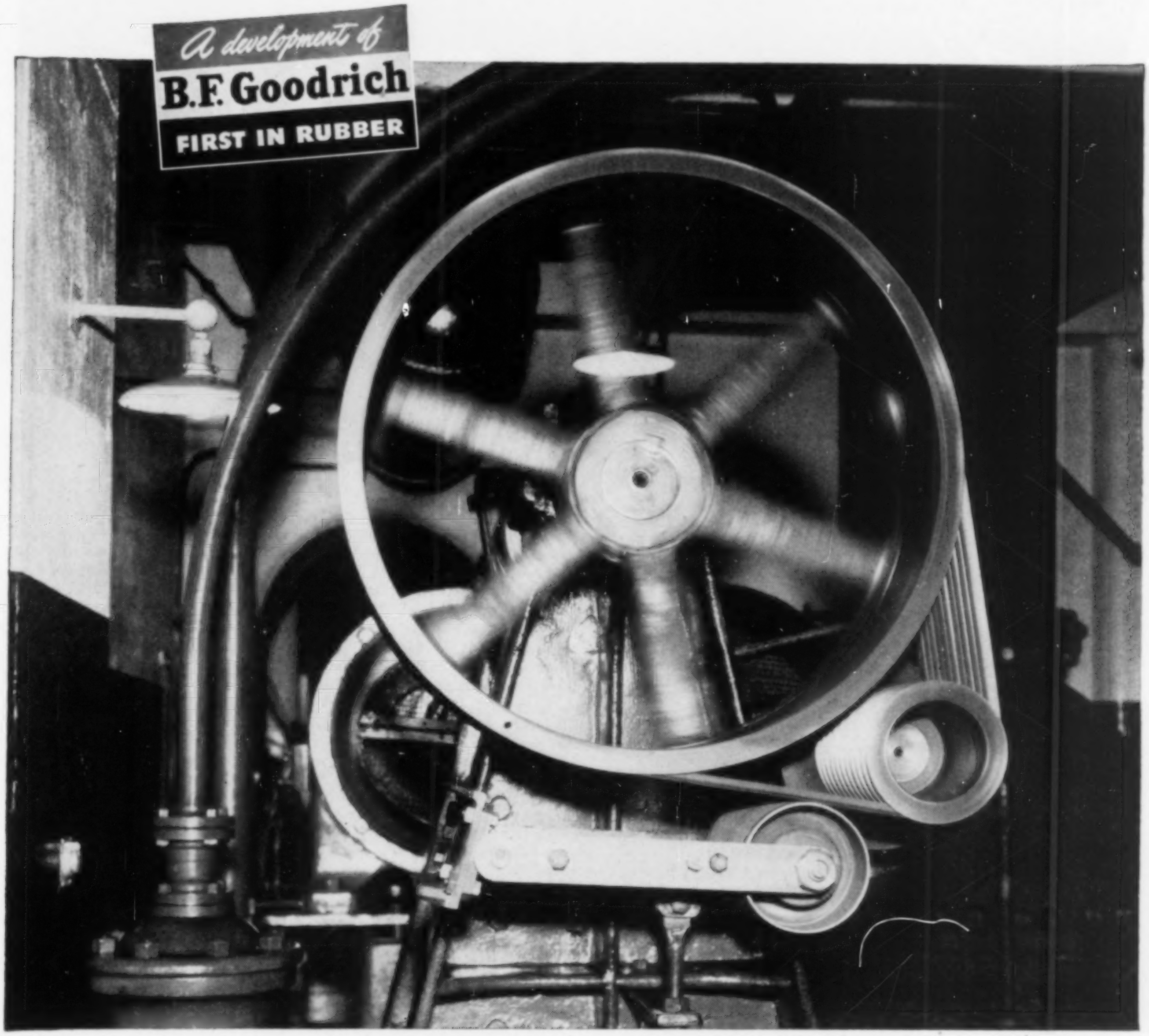

# Man missing

*A typical example of B. F. Goodrich development in rubber*

THE man who *isn't* in the picture is the important part of this story. He's the maintenance man who used to spend long hours—and many dollars—repairing the drives on oil pumps like this one in a southern power plant. They had two pumps for each generator because they knew that breakdowns were inevitable. And if oil failed to reach the generator bearings, thousands of people would be without light and power.

They thought of replacing the noisy, hard-to-maintain gear drives with V-belts something like the one that drives the fan in your car. Many years ago B. F. Goodrich developed the very first V-belt for just that purpose. V-belts are strong, quiet and need very little attention once they're installed. But they do stretch slightly. And there was no way to take up more than a fraction of an inch stretch on these drives.

Then the superintendent heard of the B. F. Goodrich wire grommet V-belt. In it, two endless steel cables—called grommets—are embedded in abrasion-resistant rubber. This belt was developed by B. F. Goodrich for heavy duty service where low stretch and high flexibility were needed. A test set was installed on one of the drives a year and a half ago. These belts have run 24 hours a day since then *with absolutely no stretch—and absolutely no maintenance.* Now, the rest of the drives are being equipped with grommet belts. That's why the man is missing from the picture. They don't need him on that job any more—a typical result of the steady improvement that is being made in rubber products by B. F. Goodrich research. *The B. F. Goodrich Co., Industrial Products Division, Akron, Ohio.*

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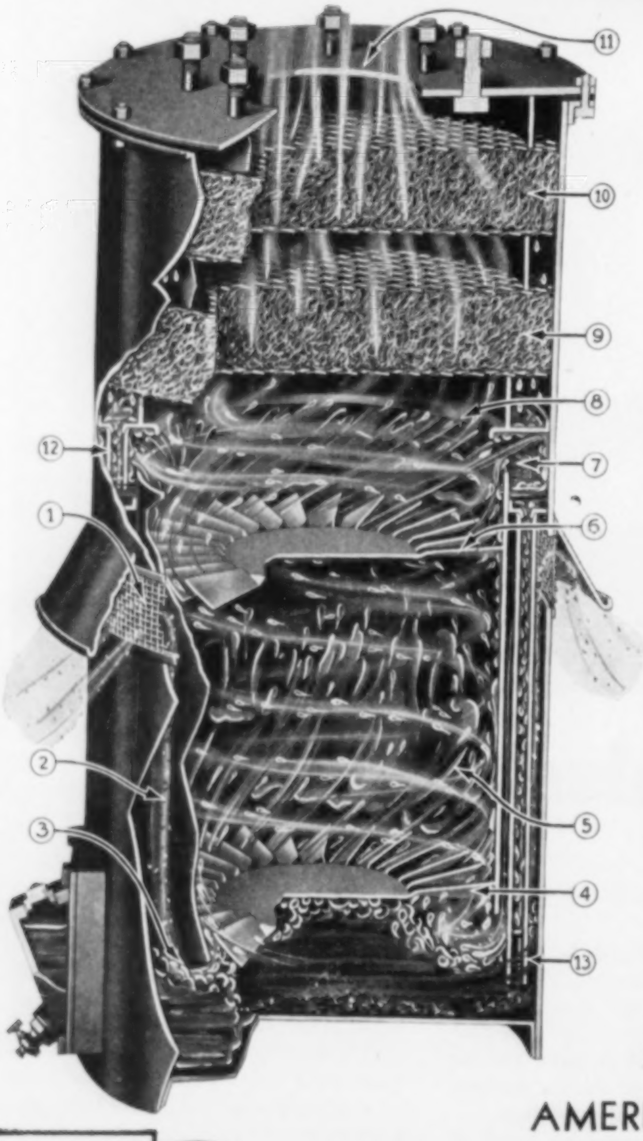


The Cycoil differs from all other Oil Bath Cleaners in that it combines four well-known air cleaning principles—Impingement, Washing, Scrubbing and Filtering—to provide the high efficiency in dust removal for which it has established an enviable reputation among engine manufacturers and users.

Its efficiency at 25% rated capacity is 99.65% and at full rating, 99.91%. How this high, uniform efficiency is obtained over such a wide variation in air volume is shown by the method of operation in the cut-away section.

Dirty air enters under the rain shield and passes thru removable bug screen (1), then passes downward thru the space (2) between the inner and outer cylinders. At (3) it impinges against oil, depositing the heavier dust particles immediately, picks up oil and then passes upward thru vanes (4) which impart a whirling motion to the air and oil mixture. In chamber (5) the whirling air and oil are thoroughly mixed and the centrifugal action developed throws a large portion of the dust against the oil-coated walls of the inner cylinder. The air-oil mixture then passes thru vanes (6) which impart a still faster whirl, throwing the oil with the dust it has collected outward by centrifugal action. At the top of the cylinder (7) is an enlarged chamber into which most of the oil and dirt are thrown from the air stream. The precleaned air then passes upward thru orifice (8) and thru the double filter cells (9) and (10) leaving the cleaner at (11) to pass into the engine or compressor. The air which reaches the filter cells contains a mist of oil which is collected by the cells and drains out around the outer edges. This continuous flow of oil keeps the filter cells thoroughly washed so that any dust collected on them is immediately carried away. The oil which drains from the filter cells passes downward thru pipe (12) where it joins the oil thrown out at (7) and flows thru pipe (13) to the oil reservoir. Here the dirt settles out and the oil recirculates.

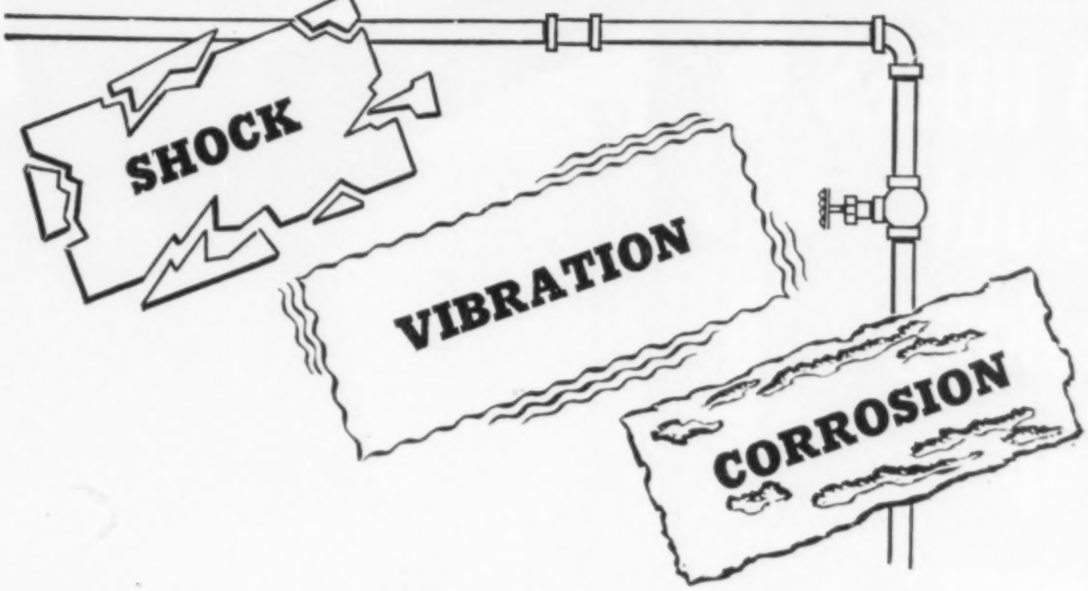
If properly maintained, it should never by necessary to remove the filter cells for cleaning, but the top is made removable and the filter cells may be lifted out, inspected, or cleaned in case unusual conditions make this necessary.

The Cycoil is made in seven sizes from 12″ to 46″ in diameter—capacities from 200 to 6400 c.f.m. Write for Bulletin No. 230D.

AMERICAN AIR FILTER COMPANY INC.,
402 CENTRAL AVENUE, LOUISVILLE, 8, KY.
IN CANADA: DARLING BROS., LTD., MONTREAL, P. Q.

AAF *Cycoil* **OIL BATH AIR CLEANER**
**AND INTAKE SILENCER**

# End the Triple Menace TO COPPER TUBE AND BRASS PIPE LINES



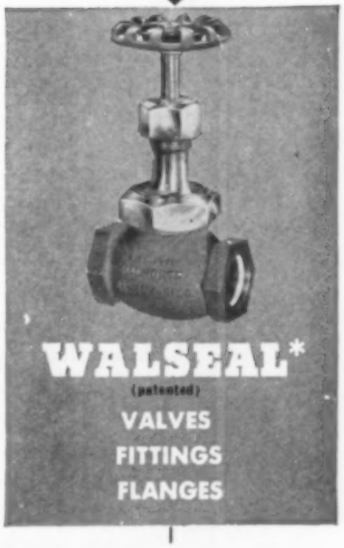
## with THREADLESS SILBRAZ* JOINTS

Shock! Vibration! Corrosion! Yes, a Silbraz Joint made with Walseal* valves, fittings and flanges "has what it takes" to overcome this triple threat to copper tube (iron pipe size) and brass pipe lines—and for keeps.

Why? Because patented Walseal valves, fittings and flanges get their *extra* stamina from a ring of silver brazing alloy built right into each port . . . an alloy that when heated with an oxyacetylene torch flows out between the pipe wall and the fitting, making a joint that is stronger than the tube or pipe itself.

In thousands of installations, these Walseal products have proved beyond dispute that they make a "one piece pipe line" . . . a pipe line that does not creep or pull apart under any shock, vibration or temperature to which the copper tube or brass pipe can be safely subjected.

Write today to Dept. 84 for Catalog 42 giving complete data on Walseal products, as well as on the entire Walworth line.



**Make it a "one-piece pipe line" with WALSEAL**

## WALWORTH

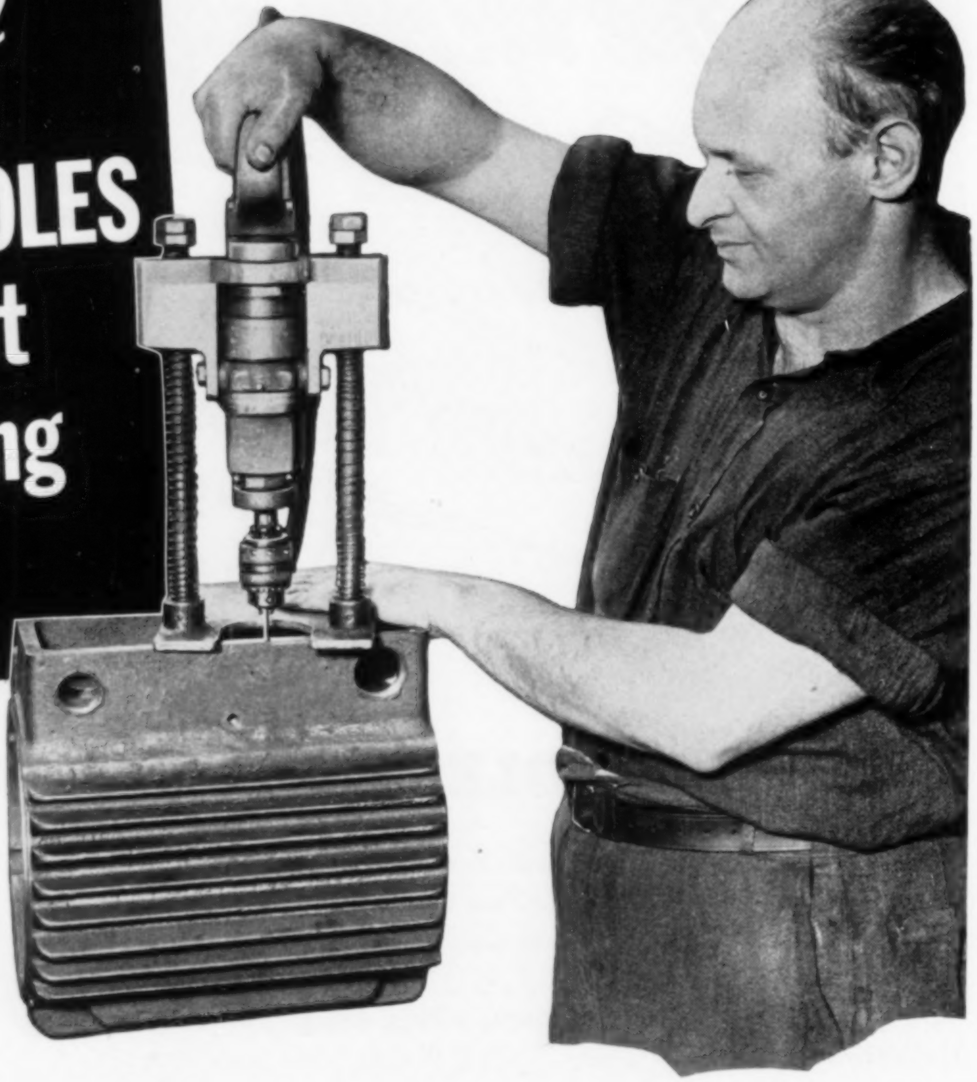
**valves and fittings**

**60 EAST 42nd STREET, NEW YORK 17, N. Y.**

**DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD**

Patented—Reg. U. S. Patent Office

# *Air Tool Threads* 8000 HOLES Without Breaking A Tap



This outstanding achievement results from several factors. The operator has complete and instant control of the Ingersoll-Rand air-powered Size 1TM Tapping Machine. Reversing the tapper is accomplished instantly without stopping the motor. A light downward pressure on the handle engages the right-hand gearing and drives the tap into the hole—a light pull back on the handle engages the left-hand gearing to back the tap out of the hole.

The air motor also permits starting the tap at slow speed, then increasing to maximum allowable speed for completion of the operation.

A special jig to hold the tapper was built by the customer. This keeps the machine at right angles to the work and speeds up repetitive operations.

*The advantages of the air tool, combined with the jig, produced 8000 holes with clean, straight threads without breaking a tap.*

You, too, may enjoy the benefits of Air Tools—Call our nearest office—one of our sales engineers will gladly assist you in selecting the proper air tools for your jobs.

SEVENTY-FIFTH IR ANNIVERSARY

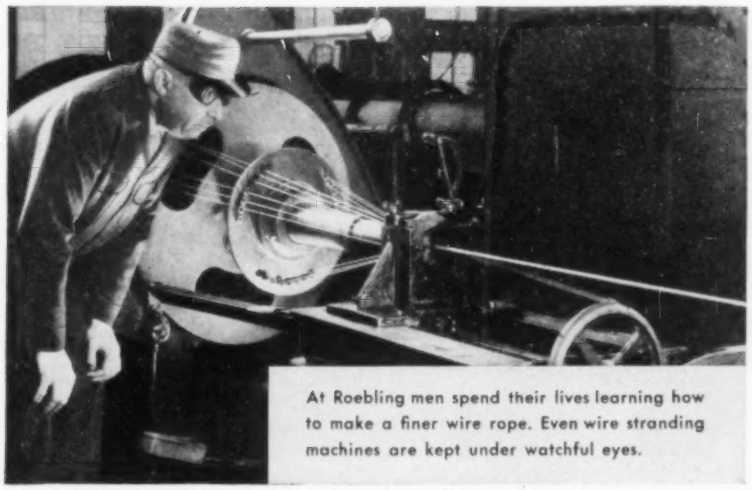
COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO BLOWERS • CONDENSERS
CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

**Ingersoll-Rand**
11 BROADWAY, NEW YORK 4, N. Y.

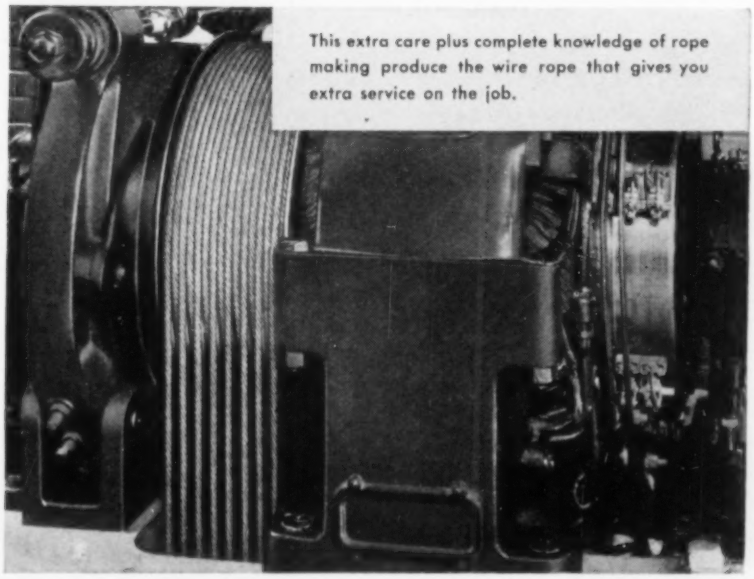
8-895

On *any* elevator: **NOTHING SERVES LIKE**

# *the right Wire Rope*



At Roebling men spend their lives learning how to make a finer wire rope. Even wire stranding machines are kept under watchful eyes.



This extra care plus complete knowledge of rope making produce the wire rope that gives you extra service on the job.

To get the best service . . . the most life from your wire rope, it's important to use the *right* rope for the job. You need the correct balance of strength and flexibility, plus the peak in fatigue and abrasion resistance. In the wide range of sizes and types of Roebling Special "Traction Steel" Elevator Rope there is one that meets your exacting requirements.

Your local Roebling field engineer will be glad to help you specify the *right* wire rope—preformed or non-preformed—to give you the most service for the least cost. Call or write our nearest branch office.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
*Branches and Warehouses in Principal Cities*

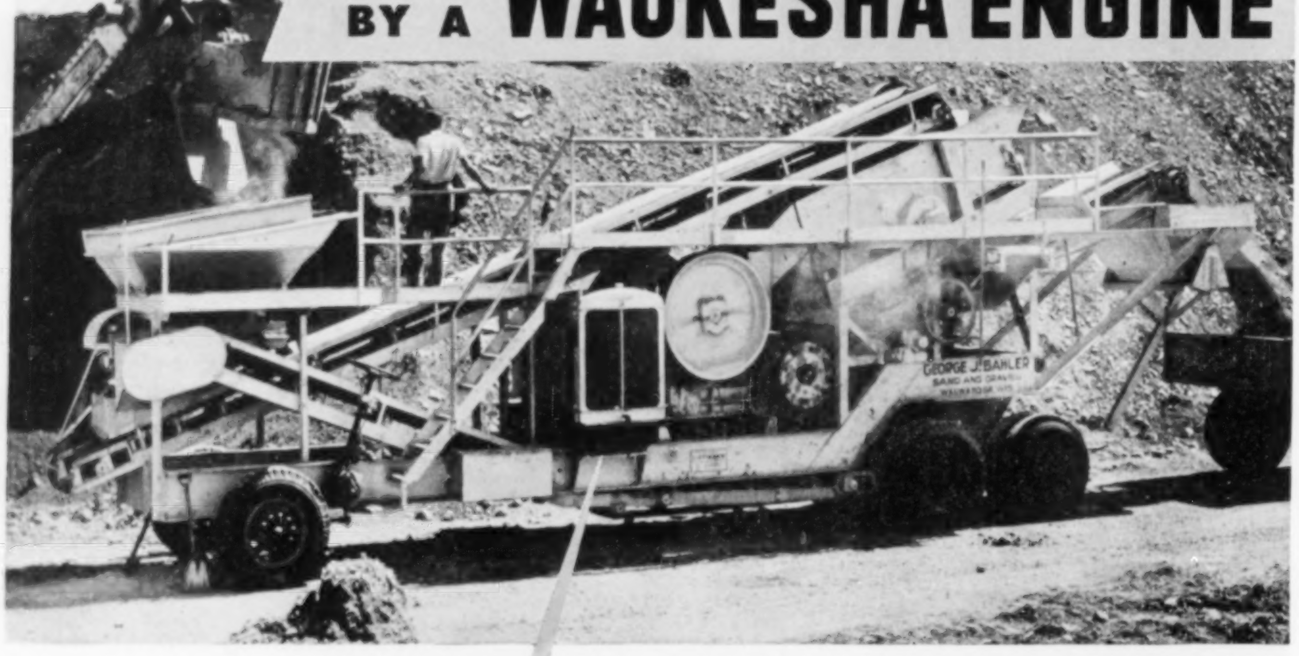
Manufacturers of Wire Rope and Strand • Fittings • Slings • Aircord, Aircord Terminals and Air Controls • Aerial Wire Rope Systems • Ski Lifts • Electrical Wire and Cable Suspension Bridges and Cables • Hard, Annealed or Tempered High and Low Carbon Fine and Specialty Wire, Flat Wire, Cold Rolled Strip and Cold Rolled Spring Steel • Screen, Hardware and Industrial Wire Cloth • Lawn Mowers

ROEBLING
TRENTON N.J.

# ROEBLING

**PACEMAKER IN WIRE PRODUCTS**

# THIS CRUSHING PLANT IS *Self-Propelled* AND OPERATED BY A WAUKESHA ENGINE



● When you want to move this Lippmann dual crushing plant from one gravel pit to another, no truck or tractor is needed to tow it. It is *self-propelled*—by its Waukesha Engine.

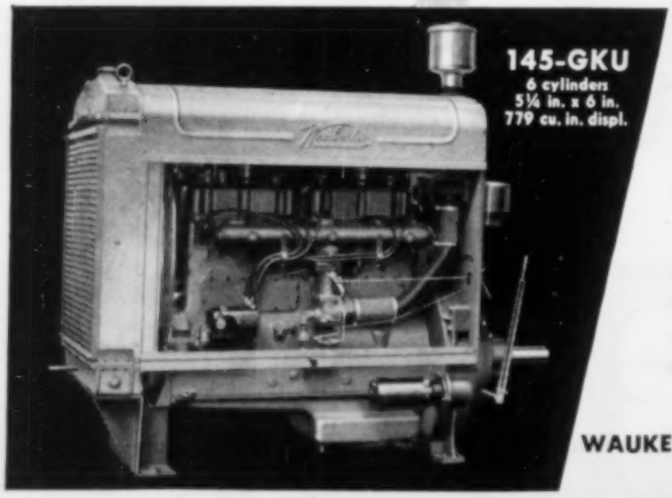
The plant is entirely self-contained. Nothing to take down or set up. With its five speeds, four forward and one reverse, the plant's one man operator-driver can not only move it, but spot it right where he wants it, at any time.

The gasoline-fueled Model 145-GKU Waukesha Engine develops 167 hp. @ 1800 rpm. for road travel. It transports the 60,000 lb. plant easily and smoothly, stepping out as fast as 30 mph. at times.

This plant is equally remarkable for capacity. It turns out a minimum of 60 yds. of minus ¾″ aggregate hourly; and has reached as high as 120 yds. in an hour. Again its Waukesha Engine contributes materially. At 1400 rpm. it develops 145 hp.—to drive the plant's 12″ x 36″ jaw crusher, 30″ x 20″ roll crusher, 2-deck vibrating screen, reciprocating feeder, and three conveyors—efficiently and reliably. It takes no time out for shutdowns and, being a Waukesha, both power and engine maintenance costs are the lowest.

The plant is made by the Lippmann Engineering Works, Milwaukee, Wis. The enthusiastic owner of the one shown is George J. Bahler, Wauwatosa, Wis.

Most contractors and other users of power-machinery are enthusiastic when it's Waukesha-powered. There's a Waukesha for your every engine need—gas, gasoline or diesel fuel. Consult Waukesha engineers. Send for Bulletin 1225.

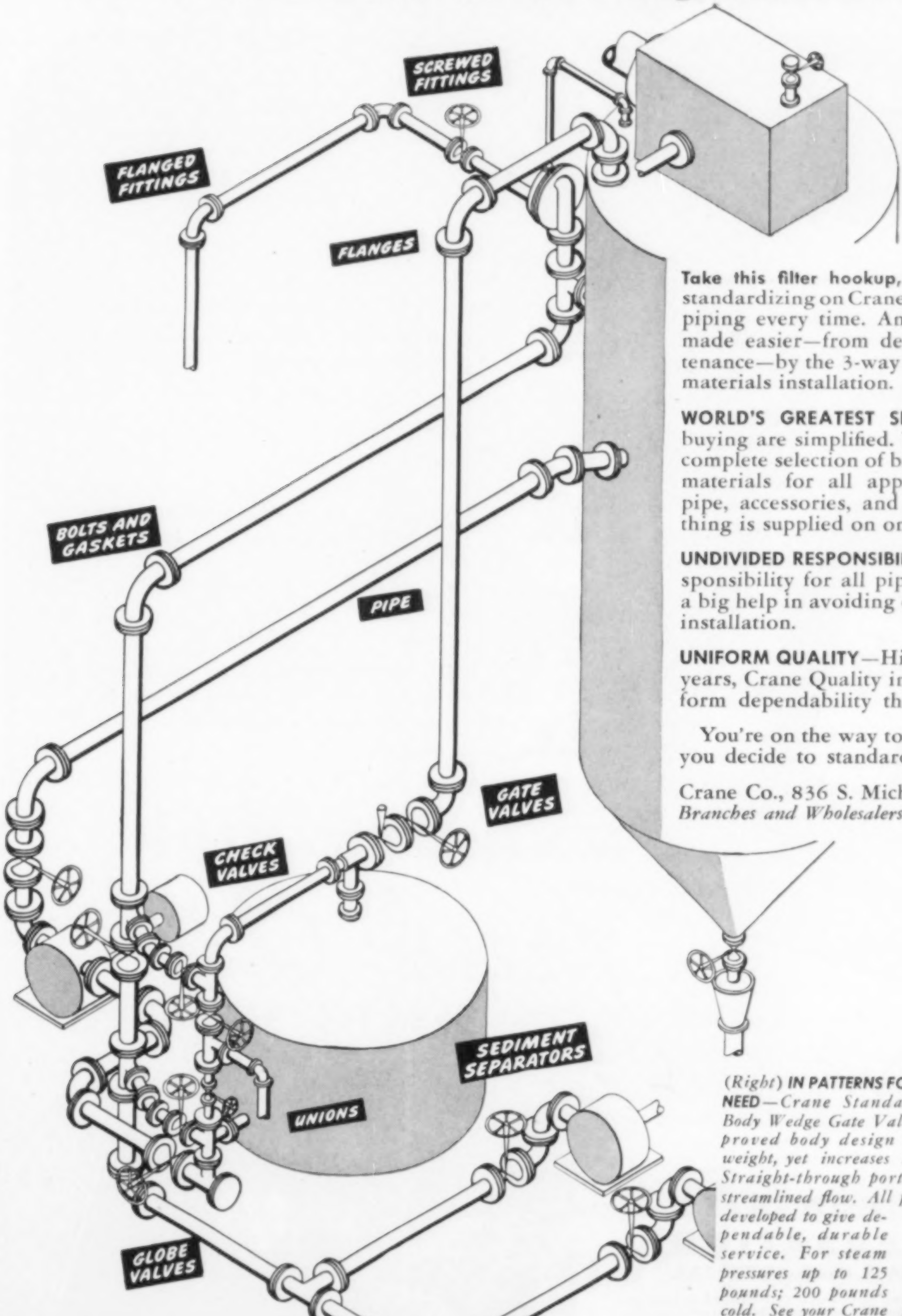


**145-GKU**
6 cylinders
5¼ in. x 6 in.
779 cu. in. displ.

**WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN**
NEW YORK • TULSA • LOS ANGELES

# WAUKESHA ENGINES

# The ONE way to better piping ...with a 3-way advantage



**ONE**

SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

**Take this filter hookup, for example,** to see how standardizing on Crane equipment results in better piping every time. And how any piping job is made easier—from design to erection to maintenance—by the 3-way advantage of an all-Crane materials installation.

**WORLD'S GREATEST SELECTION**—Specifying and buying are simplified. You choose from the most complete selection of brass, iron, and steel piping materials for all applications. Valves, fittings, pipe, accessories, and fabricated piping—everything is supplied on one order to Crane.

**UNDIVIDED RESPONSIBILITY**—You put complete responsibility for all piping materials on Crane—a big help in avoiding delays and getting the best installation.

**UNIFORM QUALITY**—Highly respected through 90 years, Crane Quality in all materials assures uniform dependability throughout piping systems.

You're on the way to better piping the moment you decide to standardize on Crane equipment.

Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.
*Branches and Wholesalers Serving All Industrial Areas*

*(Right)* **IN PATTERNS FOR EVERY NEED**—*Crane Standard Iron Body Wedge Gate Valves. Improved body design reduces weight, yet increases strength. Straight-through ports assure streamlined flow. All parts developed to give dependable, durable service. For steam pressures up to 125 pounds; 200 pounds cold. See your Crane Catalog, pp. 101-106.*

CRANE
125 S
200 WOG

**EVERYTHING FROM ...**

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

# CRANE

**FOR EVERY PIPING SYSTEM**

# YOUR FOREMEN KNOW SOMETHING SIGNIFICANT
*that your Purchasing Agent shouldn't forget* -

THE MOST DEPENDABLE METHOD OF LUBRICATION EVER DEVELOPED
Fresh Oil
MADISON-KIPP MODEL SVD LUBRICATORS
Fresh Oil...
BY THE MEASURED DROP
the most dependable method of lubrication ever developed
MODEL FD
MADISON-KIPP CORPORATION
Madison 4, Wisconsin

**i.e.** Manufacturers of the highest grade machine tools, compressors and work engines use Madison-Kipp Lubricators as standard equipment.

**i.e.** You will have trouble-free operation for 20 years and longer with Madison-Kipp Fresh Oil Lubrication.

**i.e.** Madison-Kipp is the most dependable method of lubrication ever developed.

**i.e.** To specify Madison-Kipp on all new machines you buy on which Fresh Oil can be applied, drop by drop, under pressure.

## MADISON-KIPP
## *Fresh Oil*
### FED UNDER PRESSURE BY THE MEASURED DROP

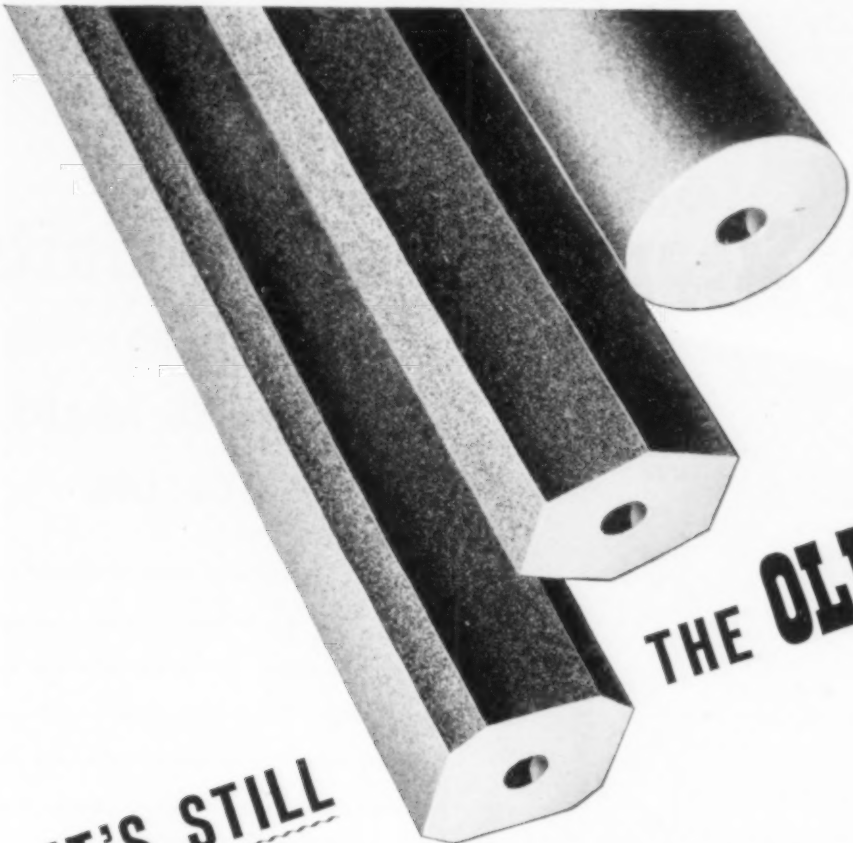
**MADISON-KIPP CORPORATION**
202 WAUBESA ST., MADISON 4, WIS., U.S.A.

Skilled in die casting mechanics, experienced in lubrication engineering, originators of really high speed air tools.

ANCIENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

*WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.*

MODEL OL
Madison-Kipp
LUBRICATORS
BULLETIN L-2360
Madison-Kipp
MODEL 50 LUBRICATORS
MADISON-KIPP CORPORATION



# IT'S STILL THE OLD RELIABLE

Years ago, on some job or other, Bethlehem Hollow was dubbed the "old reliable" drill steel.

That term has been used so much, in connection with Bethlehem Hollow, that it no longer has any originality.

Nevertheless, it's just as appropriate today as it was many years ago.

For Bethlehem Hollow is a truly reliable drill steel. Your blacksmith knows that it's uniform; makes up easily; gives him no trouble in the heat-treating stage. It can be safely hardened over a broad quenching range, and it is tough and fatigue-resistant.

It is as good for threaded rods as it is for forged-on bits. The hole is always smooth, round, and well centered—a feature that both your blacksmith and your drill runners like.

These points mean dependability. When you purchase Bethlehem Hollow, you are *getting* true dependability—and paying nothing extra.

WE BEEN USIN' BETHLEHEM HOLLOW SINCE I FIRST CAME WITH THE OUTFIT —AND THAT'S A LOT OF YEARS.
SURE — WHEN IT'S A GOOD HORSE, YOU GIVE HIM A LONG RIDE.

## BETHLEHEM HOLLOW DRILL STEEL

★ BETHLEHEM STEEL ★

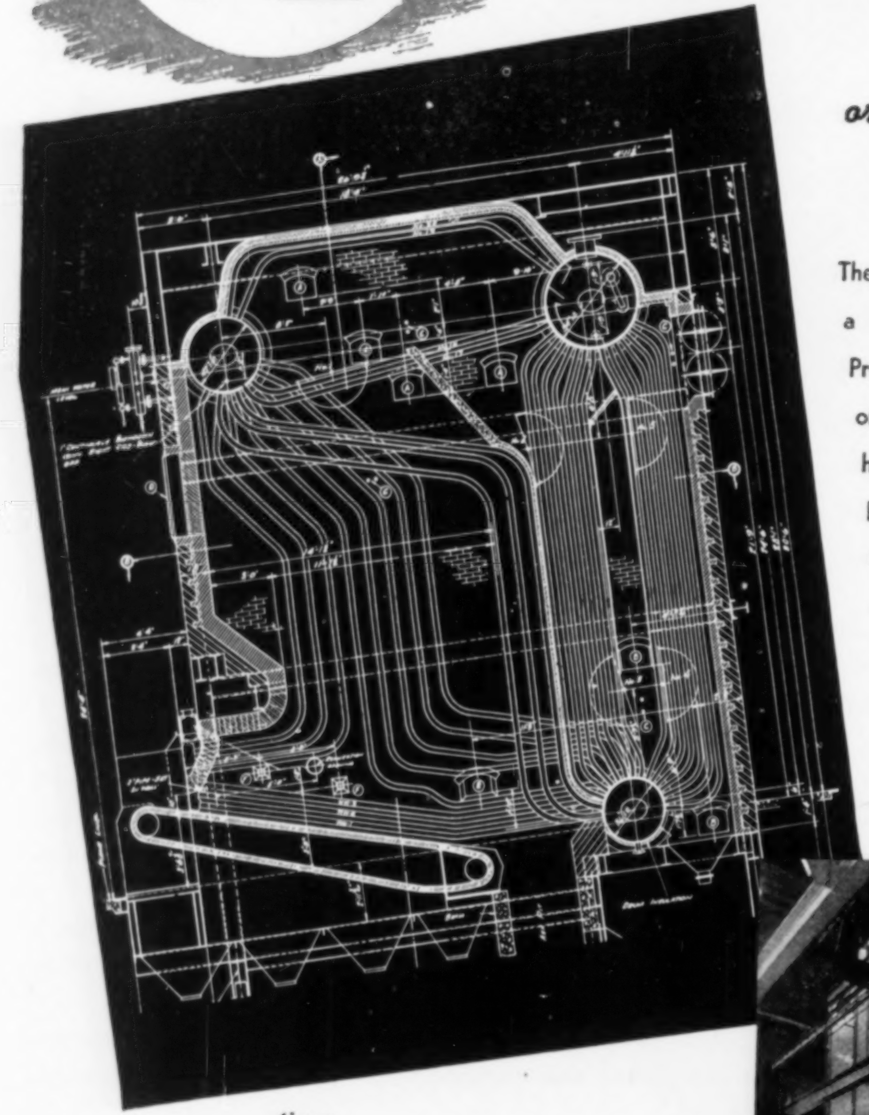
CLASS VL

Vogt

# Steam Generating Units

## *for* POWER
## *or* PROCESSING LOADS,
## *and* HEATING

The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.



*Above:*
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Vogt
FOR BETTER BOILERS

*Right:*
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

**HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.**
**Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas**

# THERE'S *More* THAN MUSIC IN THE AIR!

**THERE'S MUSIC IN THE AIR...** *stirring music by military bands. Compressed air "plays" all the wind instruments in the band, with each musician acting as his own "air compressor."*

**THERE'S POWER IN THE AIR...** compressed air power for driving a Continental Divide tunnel...for carving out the foundation of a mighty hydroelectric power dam...for mining the metals that make modern civilization possible. Compressed air multiplies man's power many times over for mining, tunneling or construction job. Air tools speed production in almost every industry.

**THERE'S FIRE IN THE AIR...** the blaze of a million furnaces smelting the ore...melting and heating-treating the metals...firing the clay...doing the thousand-and-one jobs of industry where heat is required. Turbo-blowers breathe life into those furnaces by supplying the air they need for combustion.

**THERE'S FUTURE IN THE AIR...** many thousands of applications for compressed air are already in use—many more will be found. Think of your problems in terms of air. Consult with Ingersoll-Rand when you have a job where air might be used...for more than 70 years we have made compressed air machinery our business.

IR

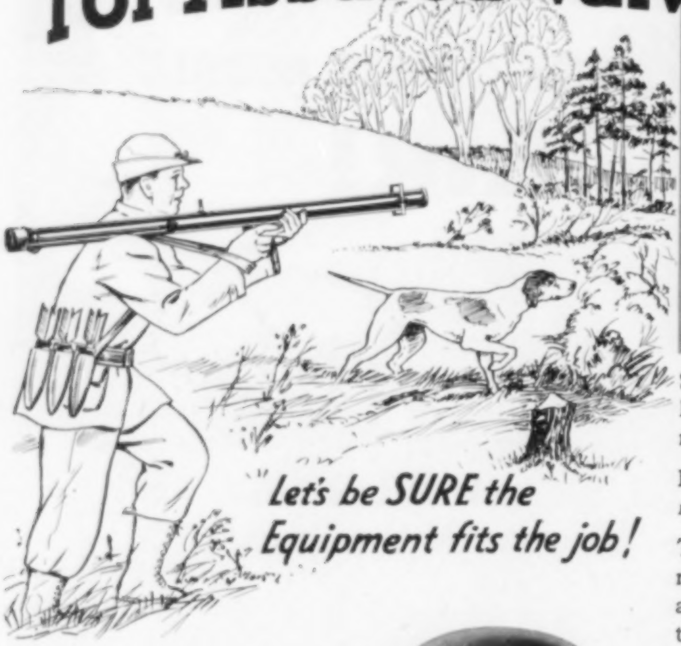
AIR TOOLS
COMPRESSORS
CONDENSERS
ROCK DRILLS
TURBO BLOWERS
CENTRIFUGAL PUMPS
OIL & GAS ENGINES

## Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 14-866

# For Assured Valve Performance

## *Consult* POWELL ENGINEERING *First*



*"Let's be SURE the Equipment fits the job!*

Shooting quail with a bazooka would be nonsensical. But trying to make a valve do a job for which it is not suited doesn't make much sense, either,

For assured performance in flow control the valve *must fit the job.*

That's why Powell maintains a staff of valve engineers who are always at your service for consultation and advice. And if you have any individual flow control problems, Powell Engineering is ready to design the correct valves to meet them.

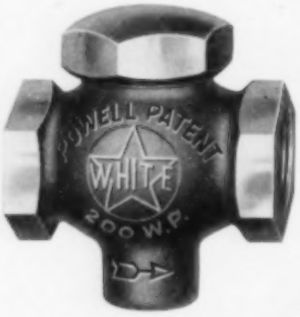


**Fig. 95**—Bronze Dash Pot Check Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed cap, and regrindable, renewable wear-resisting bronze disc. Because of the cushioning effect of the plunger in the dash pot, the seating of the disc is practically noiseless.

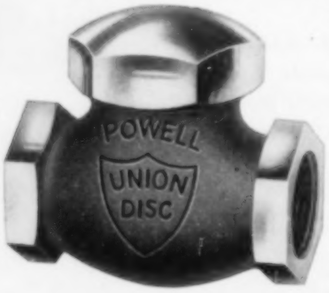


**Fig. 158**—Bronze Horizontal Lift Check Valve for 150 pounds W.S.P. Screwed ends, screwed cap and renewable vulcanized composition disc.

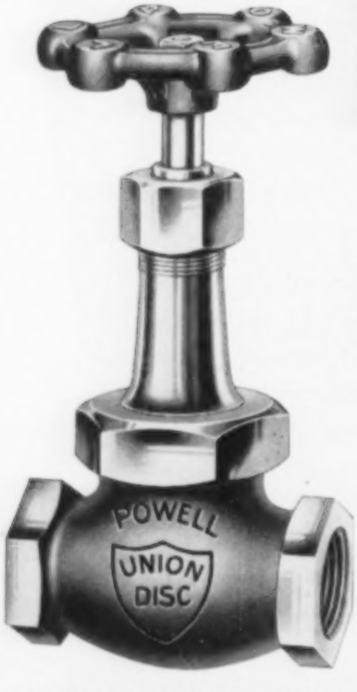


**Fig. 150**—Bronze Globe Valve for 150 pounds W.S.P. Screwed ends, union bonnet and renewable vulcanized composition disc.

**The Wm. Powell Co.**

***Dependable Valves Since 1846***

**Cincinnati 22, Ohio**

**DISTRIBUTORS IN PRINCIPAL CITIES**

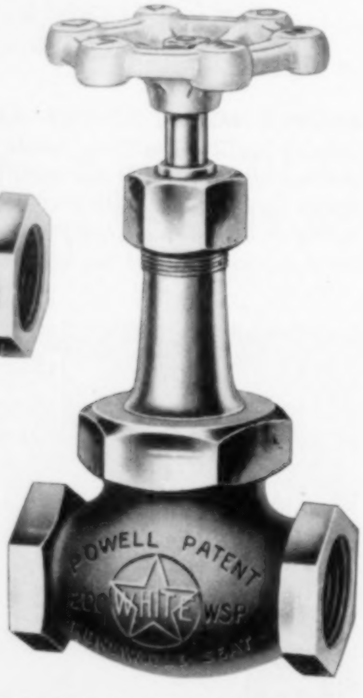


**Fig. 1708**—Bronze Globe Valve for 200 pounds W.S.P. Screwed ends, union bonnet, renewable seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze semi-cone, plug type disc.

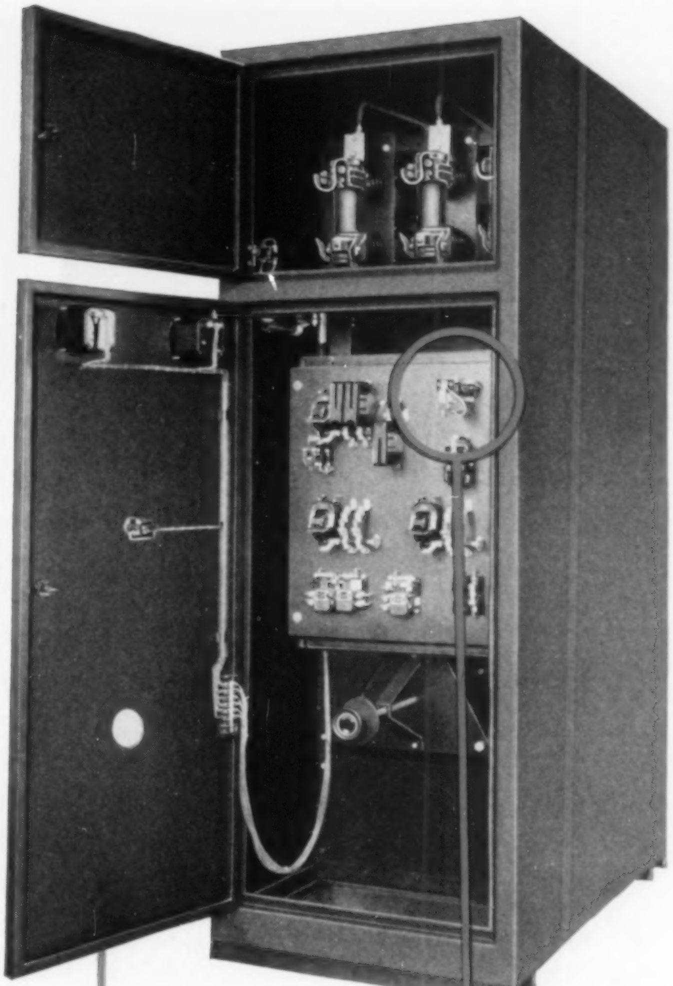
# POWELL VALVES

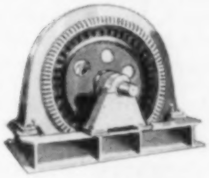
# *New!*

# "HI-FUSE"

## HIGH VOLTAGE COMBINATION CONTROL

***Assures 3-Way Protection***





- **Complete protection for your motor . . .**

- **Complete protection for the control . . .**
- **Safety for the operating personnel . . .**

Reliable synchronous motor operation hinges on dependable control. The new E-M "Hi-Fuse" control combines trouble-free PFFR ✻ starting with complete motor protection.

Newly designed for even greater protection, pre-engineered "Hi-Fuse" fills a real need. It is generally applicable without necessity of analysis of short-circuit currents. As general-purpose, high voltage combination starters for 2300 and 4000 volt synchronous motors, "Hi-Fuse" controls are the logical complement to low voltage combination starters, meeting requirements for disconnecting means, for short-circuit interruption, and for overload protection.

### CURRENT-LIMITING FUSES

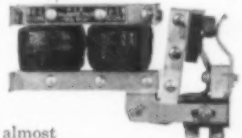
"Hi-Fuse" includes current-limiting fuses for high interrupting capacity. The new fuses provide circuit interruption within ½ cycle on faults of high or low magnitude, limiting current and voltage to safe values within ⅛ cycle.

E-M's overload or out-of-step relays operate a sturdy oil switch to add further motor protection in case of sustained overload, locked rotor, single-phasing, undervoltage or too frequent starting.

Operating personnel and low voltage control equipment are safeguarded by the new cabinet design which includes sturdy steel plate enclosures, segregated compartments and electrical interlocking.

Ask the E-M engineer in your territory for further information or write for your copy of the new "ABC of Synchronous Motor Control".

**"CONSCIOUS CONTROL" PROVIDES CORRECT, DEPENDABLE STARTING**



✻ PFFR Polarized Field Frequency Relay, operating heart of the E-M patented system of controlling application and removal of field excitation.

So highly sensitive it seems almost humanly conscious, this simple relay selects the most favorable rotor position enabling the motor to swing into step with the power lines at maximum synchronizing torque.

**E-M**

**ELECTRIC MACHINERY**
**MANUFACTURING COMPANY**
**MINNEAPOLIS 13, MINNESOTA**

***Pioneers in Smooth Starting Controls For Synchronous Motors***

A2030

## YOU GET *FULL* PRESSURE WITH LE-HI

USE LE-HI SERIES 100-B (BRONZE) UNIVERSAL TYPE AIR HOSE COUPLINGS AND BE SURE OF . . .

- ✓ *Maximum Air Flow*
- ✓ *Extra Heavy Construction*
- ✓ *Fast, Easy Coupling and Uncoupling*
- ✓ *Positive Locking*
- ✓ *Leak-Proof Seal*
- ✓ *Rust-proof Bronze Alloy*
- ✓ *Long, Trouble-Free Service*

IT'S GOOD ECONOMY TO BUY LE-HI!

Hose End

Three Way

IPT Male End

Dead End

IPT Female End

LE-HI MAKES A GOOD CONNECTION

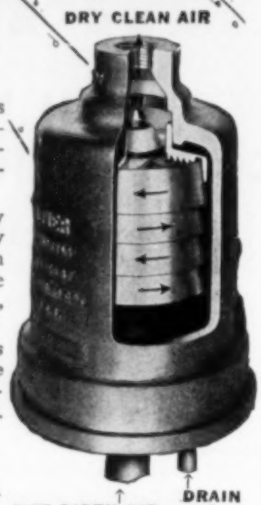
LE-HI HIGH and LOW PRESSURE HOSE COUPLINGS

SOLD ONLY THROUGH LEADING DISTRIBUTORS AND RUBBER MANUFACTURERS

**HOSE ACCESSORIES COMPANY**

2716 NORTH 17TH STREET • PHILADELPHIA 32, PA.

## CENTRIFUGAL FORCE PUTS THE rid in Aridifier!



The ARIDIFIER means good riddance to all contamination in compressed air—*constant, efficient, continuous riddance.*

Water, oil and dirt, left in air lines by the aftercooler, cause trouble. They corrode, foul and cause undue wear in air-operated tools, blemish delicate metal work, spoil sprayed finishes, clog parts, jam automatic controls.

*Stop those avoidable breakdowns and rejects! The Aridifier has the only positive principle for delivering dry clean air*—centrifugal force. Send for Bulletin 445.

WRITE TODAY

LOGAN ENGINEERING CO.
Makers of Logan Lathes
4911 Lawrence Ave.
Chicago 30, Ill.

**Logan ARIDIFIER**
Dries and Cleans Compressed Air

REMOVES OIL WATER DIRT

## HAVING TROUBLE... WITH YOUR AIR?

Air under compression is likely to carry moisture, oil or scale into expensive tools and bring them to grief. • For many years we have specialized, **pioneered** in the cleansing, drying and cooling of compressed air. Our extensive line of products contains an aftercooler, separator or automatic ejection trap that will exactly meet your need regardless of the volume of air to be processed. Every unit of recommended Murphy equipment, when installed according to directions, carries an **unconditional guarantee to completely solve your problem, or money refunded.** • Don't "baby" a bad condition! Lick it! Submit your problem **now.** There's no obligation, and you'll find our reply both prompt and helpful.

**Note:** In asking for our recommendation please state the approximate size of your compressed air system and explain briefly the condition to be overcome. Address Department C-12.

GUARANTEED COMPRESSED AIR PRODUCTS

AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS

**JAS. A. MURPHY & CO.**
HAMILTON, OHIO, U.S.A.

*Moisture Elimination Up To 3000 Pounds Per Square Inch*

## NOW you can have efficient air separators for every pneumatic tool or machine . . .

## The New AIRFUGE

It pays you to install AIRFUGE *near the work,* where unwanted moisture, dirt and sediment jams the tools, often ruins material, and causes time losses. AIRFUGE saves this annoyance — cleans air efficiently without loss of pressure. Integral trap removes condensate automatically without loss of air. Write for Bulletin S-13.

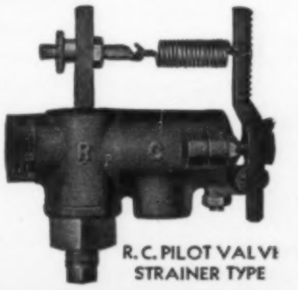
**THE SWARTWOUT CO., 18535 Euclid Avenue, CLEVELAND 12, OHIO**

## AIRFUGE

**AIR SEPARATOR AND TRAP**

## R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.

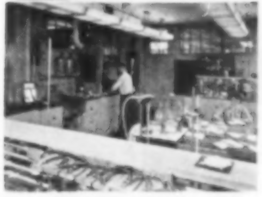


R. C. PILOT VALVE
STRAINER TYPE

## R. CONRADER CO.

**1207 FRENCH STREET - ERIE, PA.**

**PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders**



*Top*—Garlock Testing Laboratories general view.

*Center*—Another section of Testing Laboratories.

*Lower*—Chemical Laboratory

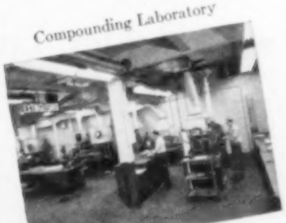
## New, Modern Facilities —

**for developing, improving and testing Garlock products**

YEARS AGO, when little was known about the laws governing "packing mechanics," The Garlock Packing Company entered into research in the field of mechanical packings. Year by year, as new industrial equipment and processes came into use, Garlock's research expanded.

Garlock's latest step forward in that direction is a new modern building at Palmyra housing a chemical laboratory with complete analytical and microscopic facilities; a physical laboratory; a rubber-compounding laboratory; an extensive test department; and a fully equipped pilot plant. These new facilities are staffed with able and experienced technicians whose entire time and effort are devoted to the development of new products and processes; the improvement of old products; and the repeated testing under actual operating conditions of GARLOCK packings, gaskets and KLOZURE oil seals.

Every Garlock product is Quality Controlled from the raw material to the final finishing operation and has a background of scientifically measured performance. More than ever before Garlock merits its slogan—*The Standard Packing of the World.*



Compounding Laboratory

THE GARLOCK PACKING CO.
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Company
of Canada Ltd., Montreal, Que.

## GARLOCK

# What does the Improved Water Resistance of the Hercomites mean to you?

Improved water resistance for the Hercomites means that the effectiveness and economy of these and most other Hercules ammonia dynamites can now be utilized in a far wider range of blasting jobs. *Investigate today.*

HERCULES
TAMPTITE

**Tamptite Cartridges save man-hours**

The new Hercomites* are available in Hercules Tamptite Cartridges. These Cartridges expand when tamped, let the dynamite fill the bore hole snugly, leaving virtually no air space. No slit cartridges . . . no spilled powder . . . but a concentrated charge, where it's most effective!

*REG. U. S. PAT. OFF. BY HERCULES POWDER CO.

*HERCULES*

XR-63

EXPLOSIVES DEPARTMENT *HERCULES POWDER COMPANY* 932 KING ST., WILMINGTON 99, DEL.
INCORPORATED

MOTOR
Snuggles Up
TO COMPRESSOR

## ...AND A BIG JOB GETS all the air it needs

This story concerns an air compressor used indoors. It tells how a G-E motor enabled the compressor to fit into a very tight space. But it applies equally well to users of air compressors on outdoor construction jobs where portability and ease of handling are important.

Back in 1943, engineers of an eastern industrial concern found that unless they could increase their compressed-air capacity quickly, vital war production was going to fall behind schedule. The problem was—where to put an extra air compressor in a plant already jam-packed with machinery.

There was just one empty corner about 10 by 12 feet in area. A compact high-speed air compressor might be squeezed in. But that left no room for a belt- or shaft-connected drive-motor. The answer was a motor that could be mounted right on the compressor—an unusally compact, close-coupled synchronous motor.

Today, both the compressor and its G-E motor can boast of a perfect three-year performance record, and the combination is still going strong. It has never failed to meet a sudden increase in compressed air demand, and has operated throughout every night shift with no more maintenance than routine inspection and lubrication.

### *Close-coupled for Economy*

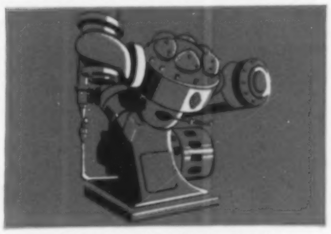
G-E close-coupled synchronous motors have won wide acceptance among compressor users in the construction field. Because the rotors are precision fitted directly to the compressor crankshaft, these motors need no outboard bearing or separate foundation. The motor air gap is uniformly and permanently maintained. Installation is simple, too—it is easy to align the motor flange with the compressor frame.

Whether you make compressors or use them, you will be interested in the design and maintenance savings made possible with compact G-E synchronous motors. Write or phone your nearest G-E office. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

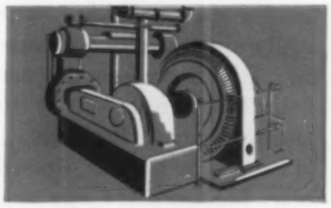
**GENERAL ELECTRIC**

750-272-8030

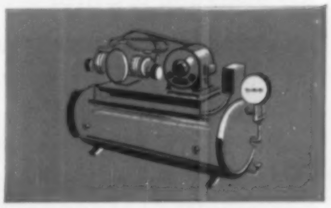
**G-E SYNCHRONOUS MOTORS FOR COMPRESSORS**



Close-coupled high speed



Direct-connected low speed



Belt-connected Tri-Clad

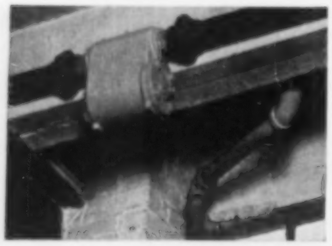
# DEPENDABLE PNEUMATIC SERVICE

IN
OUT
DRIAIR
NEW JERSEY METER CO.
PLAINFIELD, N.J.
MADE IN U.S.A.

## WHEN EQUIPMENT IS PROTECTED BY

# DRIAIR

## A COMPLETE SELF-CONTAINED UNIT



**DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.**

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper – resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

**NEW JERSEY METER COMPANY**
**PLAINFIELD, NEW JERSEY**

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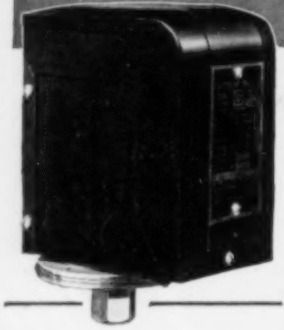
# *for* AIR COMPRESSORS *and* WATER PUMPS



## Class 9013A PRESSURE SWITCH

**225 lbs. pressure limit**
**10 to 45 lbs. differential**

● A standard controller for motor-driven air compressors and water pumps. Heavy contacts, with silver permanently bonded to the heavy bronze backing. Generous electrical ratings. Four ⅞ inch knockouts for ½ inch conduit are provided for convenient wiring.

Modern black-enameled steel cover. Corrosion-resisting inner parts. High-grade impregnated fabric diaphragm. Oil-resisting type also available.

*Write for Catalog* ● illustrations, specifications of Square D pressure switches and related devices. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wis.

**SQUARE D COMPANY**
DETROIT · MILWAUKEE · LOS ANGELES

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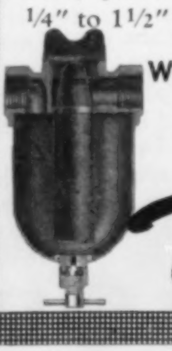
# SAFEGUARD

## *Pneumatic Equipment*
### WITH A
# NORGREN AIR FILTER

Simple, compact and positive. Double Monel wire screen stops all air-borne grit, rust and pipe scale; catches oil emulsion and moisture.

Muck falls to bottom of bowl. Open waste cock, blow it out. Indispensable in every pneumatic installation. Available 1/4″ to 1 1/2″ I.P.



**Write today. C.A.Norgren Co.**
**220 Santa Fe Drive,**
**Denver 9, Colorado.**

*Norgren*

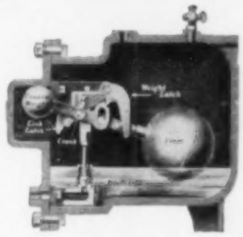
Temperamental Traps
Trouble You?

TRY

# NICHOLSON

*Weight Operated* **TRAPS**

They're widely designated where dependable positive action with maximum discharge is essential. Here are some reasons why: they're not dependent on buoyancy or weight of float . . . leak-proofed by water-sealed discharge valve . . . not easily affected by dirt, scale, pulsation, vibration or variation in pressure . . . non wire-drawing . . . sturdily designed . . . of stainless steel where it counts. Models for pressures to 1500 lbs.



*Catalog 444*
*or See Sweets*

**W.H. NICHOLSON & CO.** 180 OREGON ST.
WILKES-BARRE, PA.

**Here is the pair for clean, dry air . .**

**JOHNSON AFTERCOOLER**

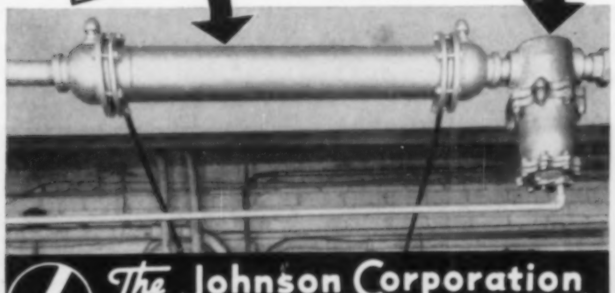
Used where moisture is vaporized by the heat of compression. Circulates cooling water around the line, condenses the oil and water vapor so Separator can remove them. Simple in design, highly efficient in performance.

SIZES FOR ALL NEEDS

**JOHNSON SEPARATOR**

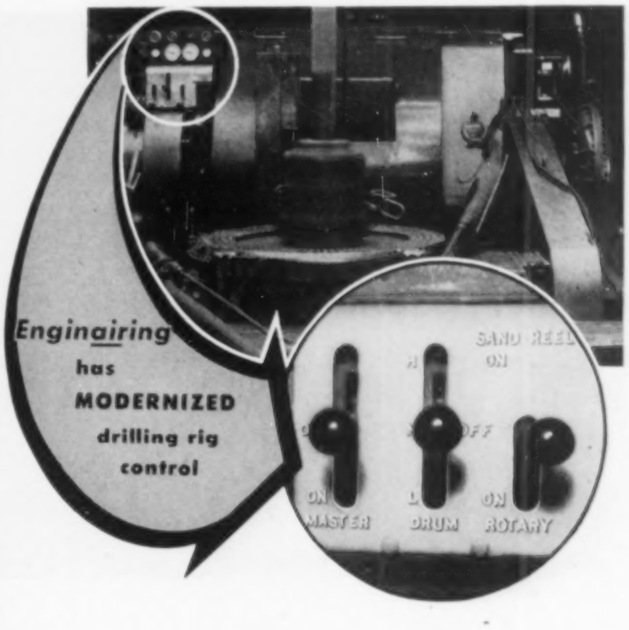
Removes more than 99% of all water, dirt and oil from compressed air or steam. Combines the *two* best principles of separation—first allows air to expand slightly, then changes flow direction with the "Thousand Baffles". Model illustrated is the newest idea in separator design, with self-draining trap mechanism built right in.

WRITE FOR BULLETIN



**The Johnson Corporation**

830 Wood St., Three Rivers, Michigan



NOW — the big engineering developments in drilling rigs have been matched by a big engin*air*ing improvement, that provides completely modern controls.

W·A·B· Controls substitute a few small valves, that can be moved with a finger-touch, for yesterday's levers and pedals. The illustration shows the simplicity and compactness of the master, drum and rotary controls.

Another big advantage is in the engine throttle control. W·A·B· devices permit a group of engines to be accurately and automatically load-balanced when compounded. This assures the most efficient utilization of available power, and eliminates the excessive wear and maintenance that may result when engines do not share the load. A change from compound to individual engine operation can be made in a moment.

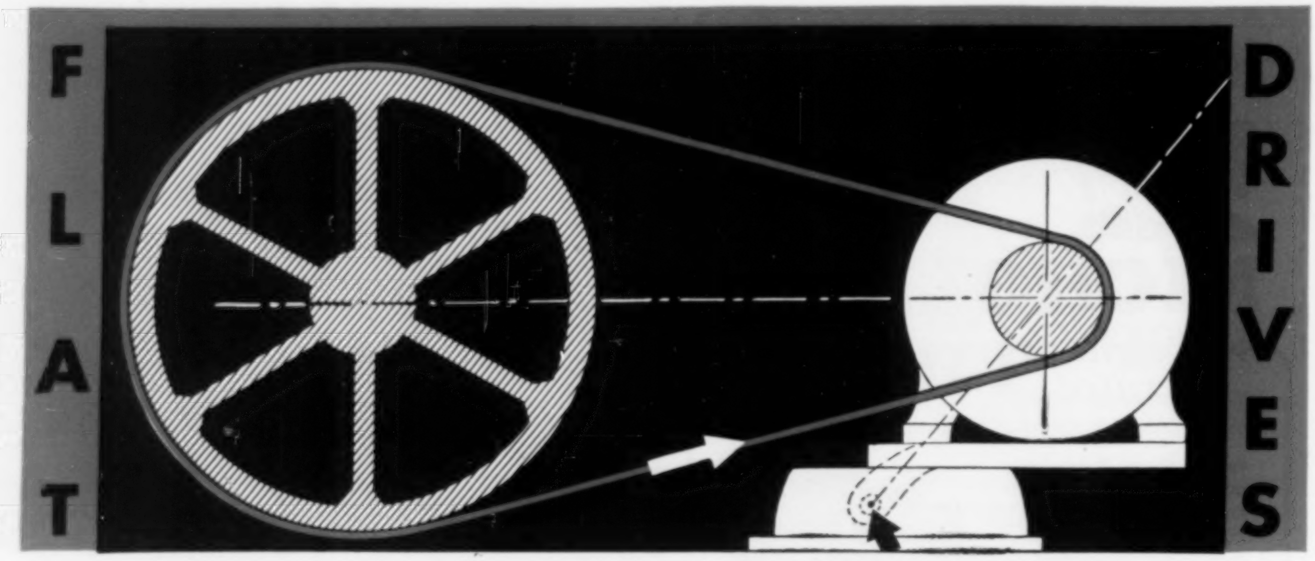
Most of the leading manufacturers offer rigs equipped with W·A·B· Controls. For tops in performance, specify W·A·B· apparatus.

PNEUMATIC CONTROLS

WABCO PACKING

**WESTINGHOUSE**
**AIR BRAKE COMPANY**

**Industrial Division - - - Wilmerding, Pa.**



# TESTED RELIABILITY FOR YEARS OF CONTINUOUS SERVICE

*Tannate* **flat leather belt** has a very high coefficient of friction and great pliability that helps keep machines running at top speed. It is treated to resist moisture, oil and weak acids. TANNATE has unusually high tensile strength which contributes toward increased service life and reduced maintenance expense.

*Rockwood* **motor base,** one or both pulleys and the belt are supplied by Rhoads. Designed to work together, they give superior performance. Maximum speed is maintained and driven machine capacity is increased when TANNATE-ROCKWOOD flat belt units are put on your drives. Get the most efficient and economical drives for your machines. Ask for further details.

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**RHOADS**
*Tannate-Rockwood*
**SHORT CENTER DRIVE**

# We thrive on the TOUGH ONES!

HE generally comes alone to see you. You called for him because something's gone wrong with a machine or process . . .

Now you tell him about it, and it turns out he knows a lot about equipment just like yours. Nine chances out of ten he can tell you right off what to do. You feel better right away.

And the tenth chance? Well, that's the tough nut. Our man goes away . . . and comes back double! Yes, he brings another man who may be a chemist . . . or a former machine designer . . . or a former shop superintendent . . . but definitely a specialist. These two men between them can almost always fix your tough nut problem.

But how about that one problem that stumps both men? Now you get something special! The research laboratory enters the picture . . . a new formula is developed . . . the refinery produces a trial lot . . . and you receive a sample.

You try the new stuff — *and it's O.K.!* Then you tell your Boss: "Sure was a headache, but here's how I licked it . . ."

And you did! Didn't *you* think of calling the Shell Lubrication Engineer?

* * *

Call your local Shell Representative, or write Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York; or 100 Bush Street, San Francisco 6, California.

**SHELL INDUSTRIAL LUBRICANTS** SHELL

# TIMKEN

## bearing equipped compressors carry on . . . .

The Ingersoll-Rand portables pictured in the photograph may be termed "old timers" in view of the length of time they have been on the job. This photograph was made in 1937 and the compressors probably had been in service long before that.

These machines do not have the sleek, streamlined appearance of the latest Ingersoll-Rand products, but their performance is characteristic. Like other models of Ingersoll-Rand anti-frictionized compressors they are equipped with Timken Tapered Roller Bearings on the crank shafts.

Full anti-friction efficiency is assured in any make or model of compressor when Timken Bearings are used, because these bearings not only eliminate friction and promote smooth, wear-free operation; they also carry radial, thrust and combined loads and hold the crank shaft in correct and constant alignment at all times, thus increasing endurance and reducing maintenance.

To make sure of getting tapered roller bearing advantages in full, look for the trade-mark "TIMKEN" on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

INGERSOLL-RAND

Tapered Roller
TIMKEN BEARING
EQUIPPED

**TIMKEN**
TRADE-MARK REG. U. S. PAT. OFF.
*TAPERED ROLLER BEARINGS*